EXPERIMENTAL

Acetone. Twelve hundred g. of acetone (commercial grade) was charged in a 2-l. distillation pot which was equipped with a thermowell and an inlet tube. The pot was attached to a 30-in. column. Between the overhead discharge of the column and the pot inlet tube was placed a catalyst bed. This consisted of 500 ml. of acetone-washed Dowex 50 (hydrogen form) in an insulated 45 × 450 mm. borosilicate glass tube. Boiling of the pot material caused the acetone vapors to pass through the column, over the catalyst and back into the distillation pot. The initial rate of acetone passing over the catalyst was 300 ml. per hour. The rate became lower as the acetone concentration diminished. Progress of the reaction was followed by the rise in pot temperature. At the beginning of the run the pot temperature was 57.8°, while at the end of the run (117 hr.) it was 87°. Distillation of the crude products gave 152 g. of acetone, 464 g. of mesityl oxide–water azeotrope, and 399 g. of mesityl oxide. This is an acetone conversion of 87.4% and a yield of mesityl oxide of 79.4% based on converted acetone.

Ethyl methyl ketone. This ketone was condensed using the same procedure and apparatus that was used for acetone. Eleven hundred ninety-six g. of ethyl methyl ketone was used. The hot vapors maintained a resin bed temperature of 70–80°. After 50 hr. the pot temperature had risen only 3.6°. (The water formed during the condensation was being recycled over the resin by means of the ethyl methyl ketone–water azeotrope, thereby inhibiting further condensation.) By distillation, 942 g. of ethyl methyl ketone and 199 g. of C_8 unsaturated ketone boiling from 77 to 83° at 50 mm. was recovered. The C_8 cut, which was a mixture of the two possible isomers, 5-methyl-4-hepten-3-one and 3,4-dimethyl-3-hexen-2-one, was redistilled at atmospheric pressure. It boiled at 155 to 167°. Molecular weight determination (by benzene freezing point depression) of a cut boiling at 158 to 161° was 127, for a cut boiling at 165 to 167° was 130; theoretical is 126. The refractive index ranged from n_D^{23} 1.4405 for the 155° material to n_D^{23} 1.4460 for the 165 to 167° cut. No effort was made to separate the two isomers quantitatively.

3-Pentanone. Twenty g. of Dowex 50 (hydrogen form) and 660 g. of 3-pentanone were placed in a 1-l. flask equipped with a magnetic stirrer and heated by the top half of a Glas-Col hemispherical heating mantle (to prevent bumping). The pot was attached to a 30-in. column. A system pressure of 200 to 300 mm. was maintained so that boiling could occur without the pot temperature reaching a point where the resin would decompose. This pressure effected pot temperatures of 50 to 75°. The system was operated under total reflux most of the time. Periodically 3-pentanone-water azeotrope cuts of 5 to 20 ml. were taken. After 54 hr. the reaction was stopped and the pot material freed of the catalyst by filtration. Distillation of the filtrate yielded 537 g. of 3-pentanone and 56 g. of 5-ethyl-4-methyl-4-hepten-3-one, b.p. 84–86° at 20 mm, d_{24} 0.856; lit.[1] b.p. 101–104° at 44 mm., d_4^{25} 0.8552.

Cyclohexanone. Twenty-one g. of dry Dowex 50 (hydrogen form) and 545 g. of cyclohexanone were charged in a 1-l., 3-necked flask equipped with a thermometer, condenser, outlet tube, and magnetic stirrer. A pot temperature of 70 to 80° was maintained. About 3 times each day for 1-hr. periods dry ($CaCl_2$) air was drawn in through the condenser, above the liquid and out the outlet tube into a dry ice trap. Water and cyclohexanone vapors were condensed forming two layers. The cyclohexanone was separated and returned to the reaction pot. During the 51.5-hr. run, progress of the reaction was followed by the refractive index change. The initial reading was n_D^{25} 1.4472 and the final was n_D^{25} 1.4960. Distillation of the filtered products yielded 142 g. of cyclohexanone and 268 g. of 2-(1-cyclohexenyl)cyclohexanone, b.p. 125° at 7 mm.; n_D^{18} 1.5072, n_D^{60} 1.4912; lit.[4], n_D^{60} 1.4918.

Acetophenone. Twenty-three g. of Dowex 50 (hydrogen form) and 618 g. of acetophenone were charged in a one-liter, 3-necked flask equipped with a magnetic stirrer. The reaction mixture was maintained at 70–75°. Water was removed from the reaction mixture as in the manner described for cyclohexanone. The refractive index of the mixture increased from an initial n_D^{25} 1.5310 to n_D^{25} 1.5670 after 246 hr. The crude products were freed of the resin by filtration and then distilled to yield 361 g. of acetophenone and 140 g. of yellow dypnone, b.p. 136–139° at 1 mm.; lit.[1] b.p. 138–140° at 1 mm. On cooling, 50 g. of 1,3,5-triphenylbenzene (m.p. 169°) precipitated from the distillation residue.

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Convenient Preparation of α-Deuterated Acids[1]

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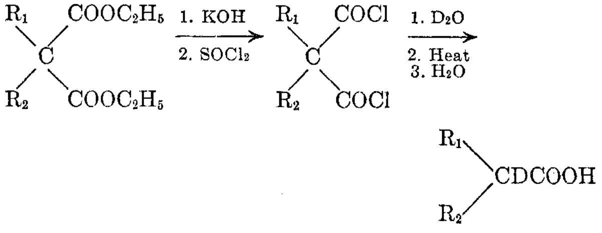
The conversion of malonic acids to the acid chlorides, followed by hydrolysis with heavy water and decarboxylation, affords a convenient procedure for the preparation of α-deuterated aliphatic and alicyclic acids offering advantages over previous procedures.[4]

α-Deutero-isobutyric and -hexahydrobenzoic acid have been prepared by the following sequence of reactions:



The yields and properties of the intermediate compounds and final products are listed in Table I.

The deuterated acids were found to have some marked differences in infrared spectra from the unlabeled analogs. These data will be presented elsewhere.

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(4) C. C. Price and H. Morita, *J. Am. Chem. Soc.*, **75**, 3686 (1953); D. G. Hill, B. Stewart, S. W. Kantor, W. A. Judge, and C. R. Hauser, *J. Am. Chem. Soc.*, **76**, 5129 (1954).

TABLE I

Substituents	$R_1 = R_2 = CH_3$	$R_1 + R_2 = (CH_2)_5$
Diethyl malonate	84% yield[6] b.p. 83° (18 mm.)–85° (19 mm.) (lit. 196.5°)[5]	50% yield[7] b.p. 74–77° (0.3 mm.) (lit. 105–106° 5 mm.)[7]
Malonic acid	90% yield m.p. 191–192° (dec.) (lit. 193–194°, dec.)[5]	70% yield m.p. 170–171° (dec.) (lit. 176°, dec.)[8]
Malonyl chloride	76% yield b.p. 156–159° (lit. 165°)[9]	68% yield b.p. 67–69° (0.7 mm.)
α-Deuterated acid	58% yield (from the malonyl (chloride) b.p. 151.8–152.2° (lit. 153.5–154.4°)[10] 1.07 atoms of deuterium per molecule of acid[12]	53% yield (from the malonyl chloride) b.p. 90.0–90.5° (1 mm.) (lit. 232.5°)[11] 1.05 atoms of deuterium pr molecule of acid[13]

EXPERIMENTAL

Hydrolysis of malonic ester.[5] The malonic ester (1 mole) is refluxed for 20 hr. with a 25% alcoholic potassium hydroxide (4 moles) solution. The reaction mixture is cautiously distilled and 60–75% of the alcohol is collected. Water (a volume equal to one-half of the original volume of alcohol in the reaction mixture) is added to the residue and the distillation is continued until all of the alcohol is removed. The residue is extracted with ether to remove any unreacted ester.

The residue is cooled and cautiously acidified with concentrated hydrochloric acid. The acidified mixture is extracted with ether. The ether is evaporated from the solution and the residue is dried in a vacuum dessicator.

Preparation of malonyl chloride. A mixture of the malonic acid 1 mole) and thionyl chloride (5 moles) is refluxed for 20 hr The excess thionyl chloride is distilled from the reaction mixture and the crude acid chloride is distilled.

Hydrolysis of malonyl chloride with heavy water and decarboxylation of the deuterated malonic acid. A mixture of the malonyl chloride and 99.5% deuterium oxide (15% excess) is cautiously refluxed for 2 hr. The mixture is heated to 30° below the melting point of the malonic acid to remove the excess water. The residue is cautiously heated to 15–20° degrees above the melting point of the malonic acid until no more gas is evolved.

The crude α-deuterated acid is dissolved in hot water and the solution is refluxed to exchange the deuterium of the carboxylic acid group. The α-deuterated acid is separated from the water and distilled.

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(5) J. F. Norris and H. F. Tucker, *J. Am. Chem. Soc.*, **55**, 4700 (1933).

(6) L. T. Thorne, *J. Chem. Soc.*, **39**, 543 (1881).

(7) A. W. Dox and L. Yoder, *J. Am. Chem. Soc.*, **43**, 1366 (1921).

(8) W. A. Wightaman, *J. Chem. Soc.*, 2541 (1926).

(9) H. Staudinger and St. Bereza, *Ber.*, **41**, 4463 (1908).

(10) W. Markownikow, *Ann.*, **138**, 368 (1866).

(11) J. S. Lumsden, *J. Chem. Soc.*, **87**, 90 (1905).

(12) Calculated from the densities of the deuterated (d^{25}_{4} 0.9594) and undeuterated (d^{25}_{4} 0.9478) acids according to the formula of McLean and Adams, *J. Am. Chem. Soc.*, **58**, 864 (1936).

(13) The acid was converted to the methyl ester which was analyzed for deuterium by densities. A mixture (d^{25}_{4} 0.9753) was prepared from 2.20 g. of the deuterated ester and 7.79 g. of the undeuterated ester (d^{25}_{4} 0,9736).

An N-Dialkylaminoalkylpyrimidine[1]

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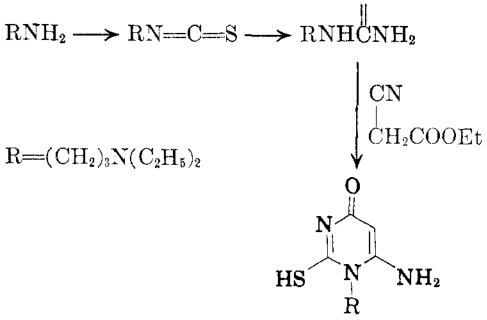
A sample of 6-amino-1-(3-diethylaminopropyl)-2-mercapto-4-(IH)pyrimidone has been prepared by the following sequence.



EXPERIMENTAL

3-Diethylaminopropyl isothiocyanate. To a stirred mixture of 20 ml. of water and 7.6 g. (0.1 mole) of carbon disulfide in an ice bath, 13.0 g. (0.1 mole) of 3-diethylaminopropylamine was added during 45 min. After the addition the mixture was stirred at that temperature for 0.5 hr. The ice bath was removed and 10.9 g. (0.1 mole) of ethyl chlorocarbonate was added to the mixture over a period of 1 hr. The solid dithiocarbamate derivative which had earlier separated gradually went into solution at this stage. After stirring for 30 min. more the solution was transferred to a separatory funnel and basified with a slight excess of concentrated aqueous caustic soda solution. The upper oily layer was separated and the aqueous portion was extracted once with ether. The combined organic layers were dried with magnesium sulfate and ether was removed at atmospheric pressure. The residue was fractionally distilled *in vacuo*, yielding 10 g. (58%) of colorless liquid boiling at 95° (3.5 mm.), (n^{25}_{D} 1.4968).

Anal. Calcd. for $C_8H_{16}N_2S$: C, 55.81; H, 9.30; N, 16.28; S, 18.60. Found: C, 55.51; H, 9.46; N, 16.30; S, 18.40.

3-Diethylaminopropylthiourea. A mixture of 10 ml. of concentrated ammonium hydroxide solution and 10 g. (0.058 mole) of 3-diethylaminopropylisothiocyanate was heated on a steam bath for 30 min., cooled, and treated with 10 ml. of acetone. On scratching, the thiourea was obtained as a white crystalline solid (10 g., 91%) melting at 97°. After recrystallization from acetone, the thiourea melted at 98°.

Anal. Calcd. for $C_8H_{19}N_3S$: C, 50.79; H, 10.06; N, 22.22; S, 16.92. Found: C, 50.87; H, 9.93; N, 22.20; S, 17.00.

6-Amino-1-(3-diethylaminopropyl)-2-mercapto-4-(1H)-pyrimidone. 3-Diethylaminopropylthiourea (9.5 g., 0.05 mole) was dissolved in a solution of sodium ethoxide in ethanol pre-

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