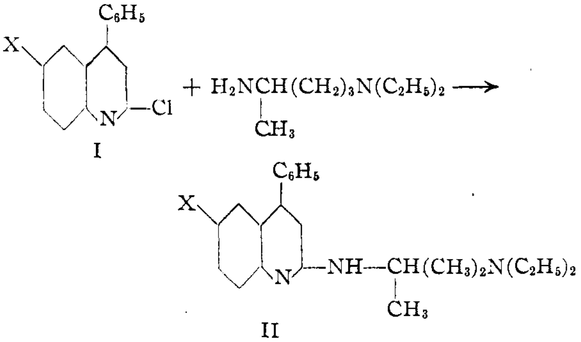
preparation of compound (II, X = H), which is structurally similar to certain antimalarial and other drugs. The side chain was attached to the heterocyclic nucleus by coupling the halogen compound with 1-diethylamino-4-aminopentane (Noval diamine). The coupled product formed solid salts with hydrochloric, hydroiodic, and meconic acids, but these salts were very hygroscopic and attempts to isolate them in the pure condition failed.



In a similar manner, the 6-chloro derivative (II, X = Cl) was synthesized by coupling Noval diamine with the 2,6-dichloro compound (I, X = Cl), which was prepared from *p*-chloroaniline and ethyl benzoylacetate followed by treatment with phosphorus oxychloride. Cyclization of the intermediate anilide was unusually difficult to effect, overnight heating apparently being required. An attempt to isolate the pure hydrochloride salt of the coupled product was unsuccessful.

Experimental

2-(4′-Diethylamino-1′-methylbutylamino)-4-phenylquinoline.—A mixture of 20 g. (0.09 mole) of 4-phenyl-2-chloroquinoline,[1] 70 ml. of Noval diamine and 0.8 g. of copper powder was heated in a sealed tube at 180° for five hours.[2] After cooling, the contents of the tube were poured onto about 200 ml. of water and the aqueous solution extracted several times with ether. The ether extracts were dried over Drierite and the solvent distilled. The residue was distilled *in vacuo* until the temperature reached 200° at 5 mm., the distillate being discarded. The material remaining in the flask was transferred to a 10 ml. insulated Claisen flask and distilled by means of a mercury diffusion pump. There was obtained 15 g. (46%) of coupled product boiling at 160–165° at 0.01 mm.

Anal.[3] Calcd. for $C_{24}H_{31}N_3$: C, 79.74; H, 8.63; N, 11.61. Found: C, 79.74; H, 8.59; N, 11.37.

2-(4′-Diethylamino-1′-methylbutylamino)-4-phenyl-6-chloroquinoline.—A mixture of 0.25 mole of ethyl benzoylacetate and *p*-chloroaniline was refluxed for fifteen minutes, allowed to cool and the solid anilide suction filtered. Additional anilide was obtained by refluxing the filtrate and cooling the mixture, the process being repeated once again. The total amount of anilide (m. p. 156–157°) obtained was 50 g. (74%). A solution of 50 g. of the anilide in 100 g. of concentrated sulfuric acid was heated on the steam-bath for twelve hours. After cooling to about 60°, the solution was poured onto a large excess of water. The precipitate was filtered, dried and recrystallized from ethanol and water. There was obtained 29 g. (62%) of 4-phenyl-6-chloro-2-hydroxyquinoline (m. p. 253–254°). This product was converted by phosphorus oxychloride to 2,6-dichloro-4-phenylquinoline (m. p. 114–115°) in 92% (28 g.) yield.

Anal.[3] Calcd. for $C_{15}H_9NCl_2$: C, 65.70; H, 3.01; N, 5.11. Found: C, 65.75; H, 3.42; N, 4.98.

This 2,6-dichloro compound (8 g., 0.029 mole) was heated with 32 ml. of Noval diamine essentially as described above for the 2-chloro derivative, the coupled product, b. p. 295–300° at 1 mm., being obtained in 40% (4.4 g.) yield.

Anal.[3] Calcd. for $C_{24}H_{30}N_3Cl$: C, 72.79; H, 7.63. Found: C, 73.19; H, 7.22.

DEPARTMENT OF CHEMISTRY
DUKE UNIVERSITY
DURHAM, N. C.

RECEIVED OCTOBER 3, 1949

---

[2] See Bergstrom, Strutz and Tracey, *J. Org. Chem.*, **11**, 239 (1946).

[3] Analysis by Clark Microanalytical Laboratory, Urbana, Illinois.

The Conversion of Monosubstituted Malonic Esters to Malondiamides

BY PETER B. RUSSELL

During the course of some synthetic studies, at present being carried out in this laboratory, it became necessary to prepare several monosubstituted malondiamides. Compounds of this type have previously been prepared by the reaction of the corresponding dimethyl or diethyl esters with ammonium hydroxide solution or with alcoholic ammonia under a variety of conditions of time and temperature.[1,2,3,4] In the experience of these previous investigators and also in our own experience these methods are unsatisfactory. They leave much to be desired in the way to yield and also the product often contains considerable quantities of the ester-amide.

It is known that methyl esters react more readily with ammonia than do ethyl esters.[5,6] In addition it has been shown that the reaction of methyl phenylacetate with ammonia is retarded by ammonium salts and accelerated by sodium methylate.[7,8] Consequently it was considered possible that the reaction of an ethyl alkylmalonate with ammonia in methanol containing sodium methylate would result in a satisfactory yield of the diamide partly through the base catalyzed conversion of the ethyl to the methyl ester (*Umesterung*)[9] and partly to catalytic action of the sodium methylate on the reaction of the methyl and/or ethyl ester with ammonia. This view proved to be correct and treatment at room temperature of a monosubstituted ethylmalonate dissolved in methanol with a saturated solution of ammonia in methanol containing a catalytic amount of sodium methylate gave excellent (85–100%) yields of pure diamide in 20–100 hours.

---

[1] Freund and Goldsmith, *Ber.*, **21**, 1245 (1888).

[2] Meyer, *Monatsh.*, **27**, 1092 (1906).

[3] Fischer and Dilthey, *Ber.*, **35**, 849 (1902).

[4] Bischoff and Siebert, *Ann.*, **239**, 96 (1887).

[5] Baltzly, Berger and Rothstein, to be published.

[6] Gordon, Miller and Day, THIS JOURNAL, **70**, 1946 (1948).

[7] Betts and Hammett, *ibid.*, **59**, 1568 (1937).

[8] Hammett, "Physical Organic Chemistry," McGraw-Hill Book Co., Inc., New York, N. Y., 1940, p. 359.

[9] Ref. 8, p. 356.

Under the same conditions but in the absence of sodium methylate the yields were considerably lower.

The reaction appears to be applicable to simple aliphatic esters as would be expected. With ethyl diethylmalonate the same conditions gave only a small yield of the diamide (3.5%). This parallels the experience of Fischer and Dilthey[3] and of Meyer,[10] the latter was not able to detect any noticeable reaction between the substances while the former workers obtained only a 1.1% yield after standing two months. The purely steric situation with this ester should be no more favorable to reaction than with esters of pivalic acid which have been found[6] to react with about one-sixtieth of the speed shown by esters of isobutyric acid.

Experimental

The conversions of the esters to the corresponding diamides are summarized in Table I. To illustrate both the general method and the effect of sodium methylate conversions of ethyl ethylmalonate to ethylmalondiamide in the presence and in the absence of sodium methylate is described.

TABLE I

Ester, ethyl	Time, hours	Amide	M. p., °C.	Yield, %
Ethylmalonate	96	Ethylmalondiamide	215[3]	91
n-Butylmalonate	72	*n*-Butylmalondiamide[a]	198	87
Benzylmalonate	64	Benzylmalondiamide	224–226[4]	96
Diethylmalonate	336	Diethylmalondiamide	225[3,10]	3.5

[a] *Anal.* Calcd. for $C_7H_{14}O_2N_2$: C, 53.2; H, 8.9. Found: C, 53.2; H, 8.9.

Conversion of Ethyl Ethylmalonate to Ethylmalondiamide.—(a) In the presence of sodium methylate: The ester (10 g.) was dissolved in methanol (50 ml.) and a solution of ammonia in methanol (100 ml. of a solution saturated at 0°) containing sodium methylate (from 0.1 g. of sodium) was added. The mixture was allowed to stand in a stoppered flask at room temperature. The diamide soon began to separate. It melted at 215° (lit. gives 216°[3]) without further purification. After thirty-six hours the amount of diamide corresponded to a 62% conversion while after ninety-six hours the separated diamide together with a further small amount obtained by evaporation and acidification of the residue weighed 6.3 g. representing a yield of 91%. (b) Without sodium methylate: The above experiment was repeated but no sodium methylate was added. After sixty hours the amount of diamide separated corresponded to a conversion of about 33%. The amount separated after eighty-four hours together with a small amount obtained by removal of the solvent was 4.4 g. (62%).

---

[10] Meyer, *Ber.*, **39**, 198 (1906).

THE WELLCOME RESEARCH LABORATORIES
TUCKAHOE 7, NEW YORK
RECEIVED NOVEMBER 22, 1949

Bromination of 9,10-Dihydroanthracene

BY JOHN R. SAMPEY, ANNE K. MCCUEN AND JESSIE M. COX

There is little information in the literature on the bromination of 9,10-dihydroanthracene. Barnett[1] discusses the *cis–trans* isomerism of 9,10-dibromo-9,10-dihydroanthracene, but gives no preparation of the same. Oda[2] measured the rates of bromination without identifying any products. Graebe[3] prepared a dibromoanthracene, melting 219–220° with no details or yield given. We have studied both the photochemical and dark room bromination of peroxide free samples of this hydrocarbon under anhydrous conditions.

The addition during two hours of 0.10 mole of bromine in 50.00 ml. of carbon disulfide to 0.05 mole of dihydroanthracene in 70.00 ml. of the same solvent at 0° with a small (2″) mercury arc 6″ distant, resulted in a 51% yield of 9,10-anthracene dibromide, melting at 219–220°, and giving 46.8% bromine (theory 47.0%) by a Rosanoff analysis. Repeating the bromination in carbon tetrachloride on a boiling water-bath for forty-five minutes gave a 44% yield. Using a large arc (6″) at 4″ distance for thirty-five minutes on a water-bath with carbon disulfide as solvent, cut the yield to 24%.

The dark room bromination of dihydroanthracene gave a mixture of poly-bromo derivatives. In an overnight run with 0.10 mole of bromine in carbon disulfide with 1 g. of iodine present, 0.05 mole of dihydroanthracene gave 7% of the anthracene dibromide, melting at 220°, and 30% of tribromoanthracene, melting at 170°. Kaufler[4] gives the melting point of 2,9,10-tribromoanthracene as 171°.

Acknowledgment.—The authors are pleased to record the active interest of Dr. E. Emmet Reid in this research. Financial assistance was received from the Office of Naval Research.

---

[1] Barnett, *Rec. trav. chim.*, **44**, 218–223 (1925).

[2] Oda, *Sci. Papers, Tokyo*, **33**, no. 728, 129–208 (1937).

[3] Graebe, *Ann. Chem. Phys.*, **7**, 257–306 (1870).

[4] Kaufler, *Ber.*, **37**, 4707 (1904).

FURMAN UNIVERSITY
GREENVILLE, SOUTH CAROLINA
RECEIVED NOVEMBER 15, 1949

Spectroscopic Evidence Concerning the Structure of 2-Phenyl-4,4-dimethyl-5(4)-oxazolone Hydrobromide. A Correction

BY CURTIS W. SMITH

The present note is an attempt to correct a mistaken statement concerning the work of Hunter, Hinman and Carter.[1] In our paper[2] "Spectroscopic Evidence Concerning the Structure of 2-Phenyl-4,4-dimethyl-5(4)-oxazolone Hydrobromide" we stated: "During a study of the reaction of β-methylbenzylpenicilloate with phosphorus tribromide, collaborators from the University of Michigan and the Upjohn Company[1] determined the infrared absorption of a solution of the penicilloate and phosphorus tribromide in carefully dried dioxane immediately after combination and then again at short intervals. The oxazolone hydrobromide shown in the accompanying equation

---

[1] Hunter, Hinman and Carter, "Methyl Benzylpseudopenicillinate" in "The Chemistry of Penicillin," Princeton University Press, Princeton, N. J., 1949.

[2] Smith and Rasmussen, THIS JOURNAL, **71**, 1080 (1949).