

retical amount of water was collected. The reaction mixture was then cooled, washed with dilute bicarbonate solution and dried over anhydrous sodium sulfate. The product was isolated by vacuum distillation. Yields were in the neighborhood of 80–90%.

TABLE I

Esters of	B. p. °C.	p. mm.	Chlorine, %	
			Calcd.	Found
Monochloroacetic acid				
2-Phenylcyclohexyl	141–143	1.5	14.05	14.38
Butyl cellosolve	85–87	1.5	18.25	18.10
Dichloroacetic acid				
2-Phenylcyclohexyl	149–151	1.5	24.70	24.42
Cyclohexyl	80–82	1.5	33.60	33.76
Butyl cellosolve	90–93	1.5	31.00	31.25
Trichloroacetic acid				
2-Phenylcyclohexyl	157–159	1.5	32.50	32.70
Cyclohexyl	85–88	2	43.00	43.30

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(2) Deceased.

1-Benzyl-3-phenyl-2-thiohydantoin

Ethyl N-Benzylglycinate.—Ethyl chloroacetate was condensed with benzylamine according to the directions of Mason and Winder.¹ The yield of ethyl N-benzylglycin-

(1) Mason and Winder, *J. Chem. Soc.*, 188 (1894).

ate on the second distillation, 128–131° at 6 mm., was 55%. The picrate derivative was prepared by mixing ethereal solutions of the two substances and scratching to induce crystallization. These yellow plates, washed with ether, melted 166–168° (micro-block).² A benzoyl derivative was also attempted but it could not be prepared by either the Schotten-Baumann method or by boiling with benzoyl chloride in benzene solution. This unexpected behavior prompted the attempt to form a thiourea derivative.

1-Benzyl-3-phenyl-2-thiohydantoin.—Approximately equal amounts of ethyl N-benzylglycinate and phenyl isothiocyanate were mixed in alcoholic solution and boiled for a minute or two. The product which separated on cooling was recrystallized from alcohol to give a good yield of long flat needles, m. p. 188.5–189.5° (micro-block). Instead of the expected thiourea the product indicated by analysis was the 2-thiohydantoin which resulted from cyclization of the thiourea by splitting out of ethanol. This type of cyclization is not unusual, though it generally requires higher temperatures³ or acid catalysis.⁴ *Anal. Calcd.* for C₁₆H₁₄N₂OS: C, 68.06; H, 5.00; N, 9.92. *Found:* C, 68.05; H, 5.12; N, 9.93.

NUTRITION RESEARCH LABORATORIES

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(2) Slight decomposition—as evidenced by the evolution of a distillate—was noticeable as low as 150°. This might bear some relationship to the 154° m. p. reported by Mason and Winder.¹

(3) Wheeler and Brautlecht, *Am. Chem. J.*, **45**, 446 (1911).

(4) Morton, "The Chemistry of Heterocyclic Compounds," McGraw-Hill Book Co., N. Y., 1946, p. 459.

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COMMUNICATIONS TO THE EDITOR

STUDIES OF FIBRINOGEN AND FIBRIN WITH THE ELECTRON MICROSCOPE

Sir:

Electron micrographs of metal-shadowed bovine Fraction I and human fibrinogen have been obtained showing that these materials consist largely of filamentous elements which are nodous in outline, somewhat like a string of beads, about 40 Å in diameter. Since the filaments tend to intermingle, it is difficult to measure all lengths with certainty, but such filaments as can be discerned vary in length from 300 to 1100 Å., with an average of about 600 Å. From flow-birefringence data it has been concluded that the fibrinogen particle can be represented by a prolate ellipsoid with a major axis of 700 Å. and an axial ratio of 18:1.¹ The widths observed are not appreciably different from the calculated minor axis. Numerous filaments occur with lengths close to the 700 Å. predicted, but the correlation is unsatisfactory in that flow-birefringence data indicate a constancy in length, while the electron microscope observations show a distribution of lengths. The discrepancy might be due to differ-

ences in samples or to difficulties inherent in the electron microscope methods.

An axial periodicity of about 250 Å. has been reported in bovine fibrin² after staining with phosphotungstic acid. The macroperiod is superficially similar to that in collagen³ and certain other protein fibrils. In the present investigation, electron micrographs were obtained with improved resolution, showing that in bovine and human fibrin, the macroperiod consists of narrow stain-receptive bands midway between denser and wider stain-receptive bands whose average distance center-to-center along the fibril axis is about 230 Å. The spacing is constant to about 3% in individual fibrils, but varies by as much as 20% between separate fibrils. The fibrils appear to consist of particles having diameters in the range 30 to 50 Å. Metal-shadowing shows that the stain-receptive bands represent higher portions, indicating that the intervening regions have shrunk during drying. It is concluded that the periodic structure represents regular fluctuations in protein concentration in the originally hydrated system.

(2) C. V. Z. Hawn and K. R. Porter, *J. Exp. Med.*, **86**, 285 (1947).

(1) J. T. Edsall, J. F. Foster and H. Scheinberg, *THIS JOURNAL*, **69**, 2731 (1947).

(3) C. E. Hall, M. A. Jakus and F. O. Schmitt, *THIS JOURNAL*, **64**, 1234 (1942).