addition of solid potassium hydroxide to a commercial (Rohm and Haas) 25% aqueous solution of dimethylamine. The gas evolved was passed through two drying towers containing solid potassium hydroxide and was then condensed in a receiver cooled by a Dry Ice–acetone bath.) The mixture was refluxed for fifteen minutes after the introduction of all the amine. The condenser was then placed downward for distillation and two-thirds of the benzene was distilled. The residue on cooling deposited 298–316 g. of crude product, m. p. 122–124°. One recrystallization from dry benzene gave 274–291 g. (71–75%) of white microcrystals, m. p. 124–125°.

Anal.[1] Calcd. for $C_{10}H_{11}O_3N$: C, 62.16; H, 5.74; N, 7.25. Found: C, 62.20; H, 5.53; N, 7.14.

(1) Microanalyses were carried out by Miss Theta Spoor.

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2-Keto-7-*n*-propylhexamethyleneimine and 6-Aminononanoic Acid

2-Keto-7-*n*-propylhexamethyleneimine.—2-*n*-Propylcyclohexanone oxime, m. p. 65–66° (uncor.),[1] 1.7 g., was rearranged in 92% sulfuric acid essentially according to the procedure of Marvel and Eck.[2]

(1) Vavon and Anziani, *Bull. soc. chim.*, **41** (4), 1638 (1927).
(2) Marvel and Eck, "Organic Syntheses," **17**, 60 (1937).

The relatively high acid concentration has been reported to be conducive to higher yields.[3] The product, 2-keto-7-*n*-propylhexamethyleneimine, after being vacuum distilled as the residue from a chloroform extraction of the neutralized reaction mixture, melted at 97–98° (uncor.).

Attempted fractional crystallization of the product from chloroform–petroleum ether resulted in a 97% yield of the lactam, m. p. 100.5–101.5° (uncor.). Only a trace of partially crystalline residue remained.

Anal. Calcd. for $C_9H_{17}ON$: C, 69.68; H, 10.97. Found: C, 69.84; H, 11.13.

6-Aminononanoic Acid.—By hydrolysis of the lactam there was obtained the corresponding amino acid hydrochloride; it did not crystallize. After treating the hydrochloride with silver oxide, 6-aminononanoic acid was isolated, m. p. 198.5–199° (temperature rise of 4°/min.).

Anal. Calcd. for $C_9H_{19}O_2N$: C, 62.39; H, 11.05. Found: C, 62.34; H, 11.01.

The formation of but one isomer during the Beckmann rearrangement of a 2-alkylcyclohexanone oxime is in accordance with previous results.[3,4,5]

(3) Hildebrand and Bogert, THIS JOURNAL, **58**, 650 (1936).
(4) Wallach, *Ann.*, **389**, 169 (1912).
(5) Ungnade and McLaren, *J. Org. Chem.*, **10**, 29 (1945).

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COMMUNICATIONS TO THE EDITOR

SMALL-ANGLE X-RAY DIFFRACTION STUDIES ON MUSCLE

Sir:

A type of protein fibril (I), distinguished by a certain large structural pattern, has been described for molluscan muscles.[1,2] Recently another variety of fibril (II) has been identified in the same and other muscles by means of small-angle X-ray diffraction. The relatively widespread occurrence of the type II fibrils is presumptive, although purely circumstantial, evidence that they are related to the fibrous protein, myosin.

Diffractions characterizing both types of fibril have been observed in the following muscles: the adductor muscles of the molluscs *Venus*, *Anodonta*, *Pecten*, *Mya* and *Mytilus*, and the retractor muscle of the sipunculid annelid, *Phascolosoma*. The first three muscles possess both white and tinted portions, the colorless components being more purely type I, the colored ones showing relatively more type II. While these muscles have been variously classified histologically,[3] the colored Pecten component alone seems definitely cross-striated and not to possess the type I fibrils. The striated frog sartorius and the smooth dog retractor penis muscles also exhibit only the type II diffractions.

The new diffraction system (II) is generally faint, diffuse and susceptible of damage by physical and chemical manipulation of the muscle. The best patterns have been obtained from *Venus* (pink component) and *Mya* muscles, in which type II fibrils are plentiful and are also undoubtedly stabilized by the accompanying type I component. As with other protein fibers,[1] the small-angle diffractions of system II are almost exclusively exhibited near or on the pattern meridian. The diffraction positions correspond to the following calculated spacings[4]: 58, 51, 27.2, 18.7, 13.8, 11.2, 9.2 and 6.9 Å. From such pattern details as sharpness and concentration of intensity with respect to the meridian, it seems probable that the structure involved is similar to that found for system I,[2] except that the repeating units are much smaller. The following tentative comparisons can be made: Fiber axis periods are 725 (I) and possibly 350 to 420 Å. (II); meridionally accentuated diffractions are orders of 145 (I) in contrast to about 27 Å. (II); and the

(1) R. S. Bear, THIS JOURNAL, **66**, 2043 (1944).
(2) C. E. Hall, M. A. Jakus, and F. O. Schmitt, *J. Applied Phys.*, **16**, 459 (1945).
(3) See H. Plenk, *Z. wiss. Zool.*, **122**, 20 (1924).
(4) I. MacArthur, *Nature*, **152**, 38 (1943), quotes measurements of W. T. Astbury, on frog sartorius muscle, which include all but the first two of the spacings given here.