tion of relative electron density along a using experimental ($0kl$) amplitude data is in satisfactory agreement with the parameter values given above.

Rubidium fluogermanate is an aggregate of K^+ and practically regular octahedral GeF_6^{--} ions (for diagrams of the structural type see ref. 1). The lattice constants and parameter values are only very slightly different from those found for ammonium fluogermanate, so that corresponding interatomic separations are virtually identical in the two cases. The near identity in the effective radii of rubidium and ammonium ions appearing in corresponding compounds has been repeatedly observed excepting in cases where ammonium ion is restricted to a small coördination number (usually four) through the formation of strong hydrogen bonds. We may conclude again[1] that hydrogen bonding plays a relatively minor role in ammonium fluogermanate.

DEPARTMENT OF CHEMISTRY
CORNELL UNIVERSITY
ITHACA, NEW YORK RECEIVED FEBRUARY 20, 1942

COMMUNICATIONS TO THE EDITOR

ELECTRON MICROSCOPE OBSERVATIONS OF COLLAGEN

Sir:

Electron micrographs have been made of collagen fibers from a variety of sources, including rat tail tendon, beef tendons and ligaments, and human skin. Fibers were obtained either by teasing small bits of tendon in water or by dissolving the material in acetic acid and reprecipitating the fibers by neutralization.

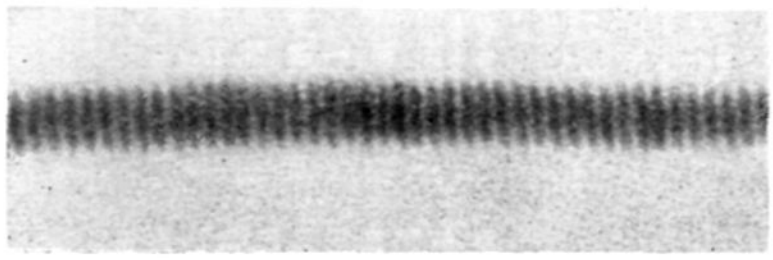

Fig. 1.—Electron micrograph of collagen fibers from beef tendon, magnification 25,000 ×.

Under appropriate conditions the fibers appear characteristically cross-striated, the relatively opaque and transparent bands extending uniformly across the fiber (see Fig. 1). The average distance between like bands can be measured with an accuracy of about 3%. The interband distance is independent of fiber width and varies considerably from one fiber to another; the extremes thus far measured are 902 and 522 Å., though the range shown in the fibers of any single preparation is more restricted.

Recent X-ray diffraction investigations in this Laboratory [R. S. Bear, THIS JOURNAL, **64**, 727 (1942)] have demonstrated the presence in collagen of a fiber-axis periodicity of approximately 640 Å. This spacing was obtained from all the types of collagen mentioned above and appears to be characteristic of this protein *in intact tissues*. There seems little doubt that the periodicities observed in the electron micrographs represent a manifestation of the X-ray diffraction periodicity in intact tendon and that the phenomenon is a consequence of the structure and arrangement of the collagen molecules in the fibers. The range of spacings observed in the electron micrographs is doubtless due to the special conditions required for the preparation of the material, chief among which are the isolation and vacuum drying of individual fibers. It is reasonable to expect individual fibers to behave different y when isolated than when present in compact bundles as in normal tendon where lateral restraints, possibly by enclosing membranes and cement substance, restrict their behavior mechanically. This interpretation is being tested by an X-ray diffraction study of teased fibers similar to those observed with the electron microscope. In addition, the effect of various physical and chemical conditions on the appearance of the fibers in the electron micrographs is being further investigated in an effort to get more information concerning the molecular architecture of collagen.

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