synthesizer. In the large synthesizer for a 20 by ± 20 matrix of terms, construction of which is in progress, these and other imperfections are removed. Coordinate lines (of controllable intensity) are also available in the large device, so that accurate location of peaks is possible. The size and conditions of operation of the final synthesizer will be such that as many contour lines as are desired can be accommodated. The zero-level of electron density can be set in through adjustment of the overall D.C.-level of the synthesized signal.

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R. Pepinsky
D. Sayre

Alabama Polytechnic Institute,
Auburn, Alabama.
March 11.

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Low-Angle X-Ray Diffraction Pattern of Collagen

It is generally accepted that the low-angle X-ray diffraction pattern of collagen is unidimensional in the direction of the fibre axis with a fundamental period of 640 A. [1]. Variations in the water content of the fibre, effected by a control of the ambient relative humidity during the X-ray exposure, alter this spacing from 628 A. at 2 per cent relative humidity to 672 A. at 100 per cent relative humidity. This continuous increase in spacing is accompanied by drastic fluctuations in the relative intensities of the various orders.

If the uptake of water by the collagen produced a uniform extension of the molecule, no change in the intensities of the orders in the diffraction pattern would be observed. The intensity variations of the reflexions which do occur can only be explained by a non-uniform alteration in the electron density. As the most significant intensity changes occur in the low-order reflexions, the increase in spacing brought about by water absorption could be interpreted as water entering between the collagen molecules, thus influencing molecular packing. Any non-uniform change in the molecular configuration, such as an alteration in the spacing of certain atomic groups, would occur over relatively short distance in the molecule and would affect the intensities of the high-order reflexions accordingly. Perutz[2] has observed similar effects in the variations in the intensities of reflexions in the X-ray diffraction patterns of crystalline proteins.

The source of collagen used for this X-ray diffraction study was kangaroo tail tendon, since a high degree of orientation is present in the natural state of the material. By staining all the samples with an unbuffered 1 per cent solution of phosphotungstic acid, the intensity of all the reflexions was increased (thus reducing the required exposure time), with no apparent alteration of the diffraction pattern.

INTENSITY OF ORDERS

Relative humidity	100%	100%	90%	55%	30%	20%
Order number						
2	2	1	6	13	7	9
3	21	24	21	16	13	17
4	5	6	13	12	9	14
5	58	53	36	13	14	12
6	14	13	28	26	24	39
7	30	31	22	12	12	13
8	14	18	18	12	10	12
9	29	29	27	18	13	14
10	5	4	4	2	2	1
11	8	9	9	6	3	4
12	8	8	4	3	3	3
13	5	4	5	5	3	2
14	2	3		2		2
15	5	6		3		2
16	2	2		2		1
17	4	4		4		2
18	4	4		3		
19	4	5				2
20	4	5				
21	3	1				
22	3	3				
23	1	1				
24	2	1				
25	2	3				
26	2	3				
27	2					
Fundamental spacing in A.	672	666	655	646	636	630

The accompanying table indicates the humidities at which the diffraction patterns were photographed, the corresponding fundamental spacings, and the intensities of the various orders as measured by densitometric methods. Accurate comparison of these films is not possible because of variations in sample thickness and in film development. Recently, a second series of diffraction patterns has been photographed in which the same sample was used throughout, and all films were processed simultaneously. This procedure permits the desired accurate comparison of intensities. Further experiments are now in progress.

Barbara A. Wright

Research Division,
United Shoe Machinery Corp.,
Beverly, Mass.
Feb. 20.

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X-Rays and the Eigen-Vibrations of Crystal Structures

In evaluating the effect of the atomic movements in a crystal on the propagation of a beam of X-rays through it, such of these movements as may be identified with the elastic modes of vibration of the solid may be taken up first for consideration. Each of these modes presents a distinctive pattern of nodal surfaces, the frequency of the oscillation being the same everywhere and the phase being opposite in every pair of adjacent cells in the pattern. The configuration of the nodal surfaces in any given mode is determined by various *macroscopic* factors, namely, the form of the crystal, the external boundary conditions and the elastic anisotropy, besides being dependent on the frequency of the mode. Hence, it would bear no particular relation to the atomic architecture of the crystal and would also be different for each of the numerous possible modes. These circumstances have important consequences in relation to the optical aspects of the problem. Each atom in the track of the X-ray beam may be con-