LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Structure of the Synthetic Polypeptide Poly- γ -methyl-L-glutamate

WE have made a check on the assignment of the α -helix with eighteen residues in five turns to poly- γ -methyl-L-glutamate¹ by preparing and interpreting X-ray photographs of a sample of the material. The results obtained not only support the assignment, but also indicate that the β -carbon atoms are in position 2 rather than in position 1². This is the same assignment of the β -carbon atoms as that made by Riley and Arndt³ for serum albumin, on the basis of their determination of the radial distribution function.

X-ray photographs were prepared of oriented fibres of the synthetic polypeptide, with use of copper K radiation, in cylindrical cameras, with radius 3 cm. or 10 cm., the fibre axis of the specimen being either parallel with that of the camera, or perpendicular to it and at various angles with the incident X-ray beam. The polypeptide was kindly provided by Prof. Carl Niemann; it had been synthesized, under his supervision, by Dr. R. E. Cline. Fibres were made from a solution of the amorphous polypeptide in dimethyl formamide.

The dimensions found for the hexagonal unit cell are $a = 11.58$ Å. and $c = 26.33$ Å. We believe these values to be reliable to within 1 per cent. The corresponding calculated value of the density is 1.40 gm.cm.⁻³, with an uncertainty of ± 0.04 . This value is a reasonable one, in comparison with the directly measured value, 1.31 gm.cm.⁻³, in view of the fact that the directly measured values of density of polymers are usually 5–10 per cent lower than the X-ray values. This agreement eliminates the difficulty pointed out by Bamford, Brown, Elliott, Hanby and Trotter⁴, who reported that their measurements of the X-ray photographs gave the dimensions $a = 11.95$ Å. and $c = 27.0$ Å., which lead to the low value 1.283 gm.cm.⁻³ for the density.

Bamford, Brown, Elliott, Hanby and Trotter have also stated that the observed difference in infra-red dichroism for the NH and CO stretching modes of vibration indicates that the transition moment of the CO vibration makes an appreciably greater angle with the chain axis than does that of the NH vibration, and that this fact is difficult to interpret in terms of the α -helix composed of planar amide groups. We think that it is not unlikely that the direction of the effective electric moment vector for one or both of these vibrations deviates significantly from the internuclear direction, and that the difference in dichroism results from this effect.

The striking agreement in the distribution of intensities among twenty-eight layer lines of the fibre diagram of poly- γ -methyl-L-glutamate and the intensities indicated by the first terms in the Bessel-function expansion for helical structures with eighteen residues in five turns has been pointed out by Cochran and Crick⁵ and by Bamford, Brown, Elliott, Hanby and Trotter⁴. We have obtained some additional evidence that the helical configuration is the α -helix of planar amide groups previously described¹. The observed intensities of equatorial reflexions agree well with those calculated by averaging the atomic positions over a cylindrical surface¹; we have now verified that the calculated intensity function ob-

Calculated intensities of fifth layer line reflexions for the 3-6-residue helix: the thin line gives the calculated intensities for the four main-chain atoms and the β -carbon atom in position 1, and the thick line those for the main-chain atoms and the β -carbon in position 2. The vertical lines represent the visually estimated intensities of the 10.5, 11.5 and 20.5 reflections; their relative values are 43, 27 and 8 respectively

tained in this way does not differ appreciably from that for the α -helix in any orientation, the change in the form factor with change in azimuthal orientation of the α -helix relative to the axes of the unit cell being very small—less than 5 per cent. Moreover, the calculated intensity for the α -helix, oriented with an α -carbon atom on the line connecting the centre of one helix with the centre of an adjacent helix, is found to agree well with the observed intensities for the three reflexions in the fifth layer line, 10.5, 11.5 and 20.5 (strong, medium and weak, respectively), when the β -carbon atoms are included in the calculation, and are placed in position 2 (z co-ordinate -0.76 in Table 2 given by Pauling and Corey²) rather than in position 1. This comparison is shown in the accompanying graph. It seems not unlikely, then, that position 2 is correct for this synthetic polypeptide, and the fact that the same position has been assigned to the β -carbon atom in serum albumin by Riley and Arndt³ suggests that this sense of the α -helix, relative to the configuration of the amino-acids, may be favoured by polypeptides and proteins generally.

We may point out that, in addition to the distribution of intensities in the layer lines, direct measurement of meridional spacings for this synthetic polypeptide supports the 18-residue 5-turn α -helix. Our measurement of the spacing of the identity distance from the second, third, fifth and eighth layer lines is 26.33 Å., and our measurement of the spacing of the Perutz reflexion, representing the axial length per residue, is 1.472 Å. The ratio of these, 17.9, is close to the value 18 required by hexagonal symmetry.

HARRY L. YAKEL, JUN.

LINUS PAULING

ROBERT B. COREY

Gates and Crellin Laboratories of Chemistry,
California Institute of Technology,
Pasadena 4, Calif. April 4.

¹ Pauling, L., and Corey, R. B., *Proc. U.S. Nat. Acad. Sci.*, **37**, 241 (1951).

² Pauling, L., and Corey, R. B., *Proc. U.S. Nat. Acad. Sci.*, **37**, 235 (1951).

³ Riley, D. P., and Arndt, U. W., *Nature*, **169**, 138 (1952).

⁴ Bamford, C. H., Brown, L., Elliott, A., Hanby, W. E., and Trotter, I. F., *Nature*, **169**, 357 (1952).

⁵ Cochran, W., and Crick, F. H. C., *Nature*, **169**, 234 (1952).