Preliminary Notes

The 1680 cm^{-1} band of ribonucleic acid in D_2O solutions

In our previous paper[1], it has been pointed out that the appearance of the absorption band at about 1710 cm^{-1} of nucleic acids may be used as a criterion of the existence of the specific base pairing. It was considered that the absorptions in the 1700–1720 cm^{-1} region are caused by the C=O and C=N stretching motions of cytosine and adenine residues, where the π-electrons are localized at these bonds to a greater extent than in the free cytosine and adenine residues, and that such a localization of the π-electrons is caused by the base–base interactions.

From our infrared studies of nucleosides[2], evidence has been obtained that absorption due to the stretching vibrations of the deuterated base residues, corresponding to absorption in the 1700–1720 cm^{-1} region of the undeuterated base residues, appears in the 1670–1690 cm^{-1} region. Therefore, for the D_2O solutions of nucleic acids the appearance of absorption in the vicinity of 1680 cm^{-1} may be used as a criterion of the existence of the base pairings.

Some of the results of our measurements of the infrared spectra of sodium salt of ribonucleic acid, prepared by the phenol method from ribosomes of *Escherichia coli,* in D_2O solution are shown in Fig. 1. It can be seen that it has a strong absorption band in the 1680 cm^{-1} region, which is a little weakened in intensity upon heating at 100° for 10 min. When the sodium ribonucleate is treated with ribonuclease, the 1680 cm^{-1} absorption is much weakened.

Blout and Lenormant[3] found that high-polymer sodium deoxyribonucleate shows a strong band at 1680 cm^{-1} in D_2O solution, and that, when the solution is heated,

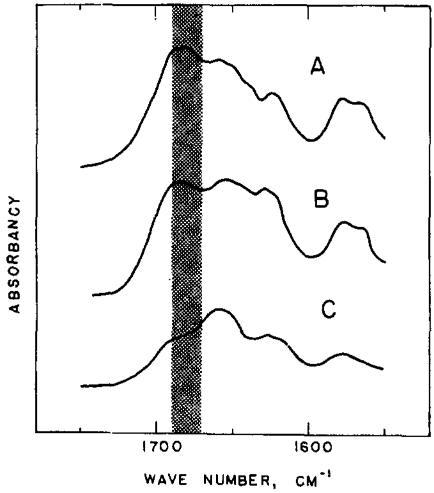

Fig. 1. Infrared-absorption curves of sodium ribonucleate from *E. coli* ribosomes in D_2O solution. A, native; B, heated to 100° for 10 min; C, treated with ribonuclease.

treated with deoxyribonuclease, or treated with alkali, its 1680 cm^{-1} band is much weakened. They also found that the low-polymer sodium deoxyribonucleate does not show the strong 1680 cm^{-1} band.

All these facts indicate, according to the interpretation based on the criterion suggested above, that the base paring takes place only in the high-polymer ribonucleic and deoxyribonucleic acids but not in the low-polymer nor in the denatured forms.

We have also observed 6-μ-region spectra of various nucleic acids and nucleoproteins in D_2O solution. The results of the observations and the interpretations on the basis of the criterion suggested here will be detailed elsewhere.

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Department of Chemistry, Faculty of Science,
Tokyo University, Hongo, Tokyo (Japan)
T. SHIMANOUCHI
M. TSUBOI
Y. KYOGOKU

Institute for Virus Research, Kyoto University,
Sakyo-ku, Kyoto (Japan)
I. WATANABE

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Infrared spectra of the three-stranded helices formed by polyuridylic acid with polyadenylic acid and with tetraadenylic acid

Infrared spectra in D_2O solutions have been used to determine the tautomeric forms of nucleotides and polynucleotides and to study the interactions of polynucleotides in aqueous solution[1]. Poly A and poly U* can interact to form either a two-stranded or a three-stranded helix depending upon conditions[2]. The infrared spectra of the two-stranded helix[1] showed a decrease in intensity of the 1632 cm^{-1} band and frequency increase of this band and of the 1660 cm^{-1} band. This note reports the spectra of the three-stranded helices formed between poly A and poly U and between tetra A and poly U. For the necessary related spectra, the assignment of bands, and the experimental methods used, previous papers[1] should be consulted.

The most striking result with the three-stranded helix concerns the 1630 cm^{-1} band. As stated above, this band is decreased in intensity in the two-stranded helix[1]. It has disappeared as a separate peak in the case of poly (A + 2 U) and of tetra A + 2 poly U (Fig. 1).

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* The polyadenylic acid (poly A) and polyuridylic acid (poly U) were prepared with polynucleotide phosphorylase (M. GRUNBERG-MANAGO AND S. OCHOA, *J. Am. Chem. Soc.*, 77 (1955), 3165). The tetraadenylic acid (tetra A = pApApApA)[3] + 2 poly U solution was the generous gift of DR. MARIE LIPSETT AND DR. LEON HEPPEL[3].