THE KINETICS OF THE RENATURATION OF DEOXYRIBONUCLEIC ACID
DENATURED IN THE PRESENCE OF COPPER(II) IONS

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SUMMARY

The transition between the double helix and the random coil configuration of deoxyribonucleic acid (DNA) is of great biological significance and in spite of considerable study over recent years, the physical chemistry of this transition is not well understood. The helix to coil transition, termed denaturation and its reverse process, renaturation, can be observed in aqueous solutions of DNA under a number of experimental conditions, but in this study, the particular case of the presence of Cu(II) ions was employed. It has been previously shown that Cu\(^{++}\) ions cause the helix-coil transition of DNA to occur at a much lower temperature than in their absence. DNA denatured under these conditions can be renatured on dissociation of the Cu\(^{++}\)-DNA complex by increasing the ionic strength of the solution or by adding a Cu\(^{++}\)-complexing agent. This renaturation reaction, proceeding rapidly to completion under conditions unfavourable for the renaturation observed in the absence of Cu\(^{++}\) ions, appeared likely to give valuable information concerning the helix-coil transition of DNA.

The rate of the renaturation brought about by increasing the ionic strength and followed by the change in UV absorption was found to depend on the ionic strength, the Cu\(^{++}\) concentration, the temperature, and on the time elapsing between denaturation and the commencement of renaturation. The data could be fitted to first order kinetics for a considerable extent of the reaction. It was found that the rate constant decreased markedly as the bulk viscosity of the solution was increased.
The renaturation was also followed by measuring the rate of increase in free Cu$^{++}$ ion concentration using a specific cupric ion activity electrode. The rate determined by this method agreed well with that obtained by spectrophotometry.

Ethylene diamine, a complexing agent for Cu$^{++}$ ions, was also used to bring about the renaturation. In this case, the reaction was observed to obey first order kinetics, to be time dependent, but to be independent of the solution viscosity.

The interpretation of these results in terms of the interaction between Cu$^{++}$ and DNA and the possible mechanism for the renaturation reaction is discussed.