Discussion Letter

The new model of DNA structures

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The new model of the DNA dynamic state is proposed in terms of Watson–Crick (WC) and Corey–Pauling–Kortum (CPK) models by the modification of the *cis* ladder conformation. The model may rationally explain the DNA replication, transcription, renaturation, hybridization, premelting and breach etc.

Watson–Crick model; Corey–Pauling–Kortum model; Dynamic model

In recent years, a model of DNA structure (known as the CPK model) including the *cis* ladder conformation [1], 'side by side (SBS) structure' [2] and Corey–Pauling–Kortum structure [3] shown in Figs 1, 2 and 3 respectively, has been proposed, which is different from the WC model, in order to overcome some of the difficulties in answering problems of DNA replication, transcription and DNA-protein interactions.

The CPK model seems to be a bending and partial twist zipper, while the WC model seems to be a fried dough twist. The main differences between CPK and WC models are as follows.

(1) Their handed sense is different. The former gives a alternating right- and left-handed helix, while the latter shows a right-handed one.

(2) The twist extent of their double strands is different. The former gives the 'side by side' structure and partial twists in a interstrand, while the latter is a double helix twist.

Crick et al. [4] negate the CPK model according to the existence of gyrase, helical enzyme and relaxed enzyme and the fact that double strands in the CPK model is not strictly side by side. We have a somewhat differing opinion from Crick on that point. In fact, it is local interstrand twists in the CPK model that can explain the necessity of existing enzymes above. But it is feasible that Crick et al. refuse the CPK model with facts of the tRNA structure and gel electrophoresis results.

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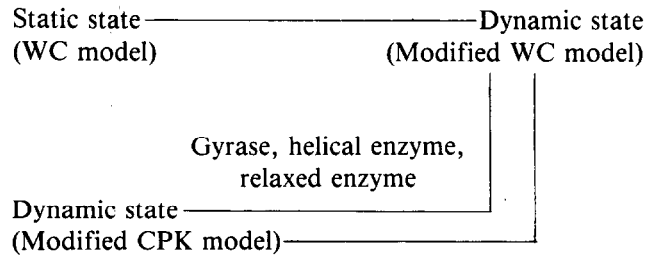
Abbreviations: WC, Watson–Crick; CPK, Corey–Pauling–Kortum; SBS, side by side.

We consider that the handed sense of the WC model is correct and its main character may be dependable. But its details need to be modified further. In addition, we think that the CPK model has certain theoretical significance. However, it also needs to be modified further. If both WC and CPK models are modified by the *cis* ladder conformation, they would be convertible, i.e.:



Both modified models mean that sugar-phosphate chains are in *cis* and bases are stacked up like a ladder.

If modified models can convert to each other their handed senses must be the same, i.e. that of the CPK model is right-handed, which can be proved by many facts. On the basis of polynucleotide backbone conformation and sugar puckering, Sasisekharan et al. have explored the WC model. The conclusion shows that right- and left-handed helices might be the same, and this is corresponding well with X-ray diffraction data. Although they are too difficult to distinguish, Sasisekharan et al. have presented the CPK model according to this precondition. Local right- and left-handed senses in the CPK model might be induced by polynucleotide conformations. It is for the basis of genetic information, that nucleotide bases do not

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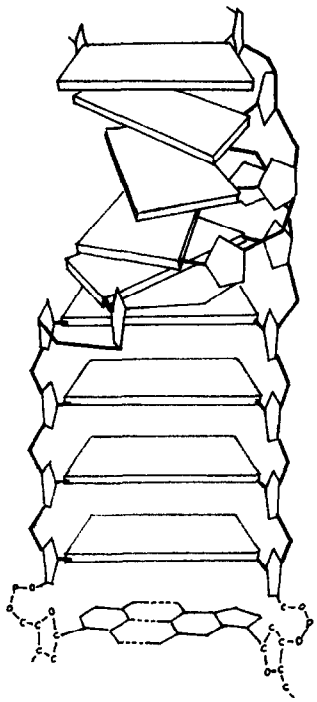

Fig. 1. *Cis* ladder conformation. Nucleotide is the *cis* ladder conformation at the bottom. It is the double helix at the top. The model shows that conversion between conformations is possible in the absence of any pull.

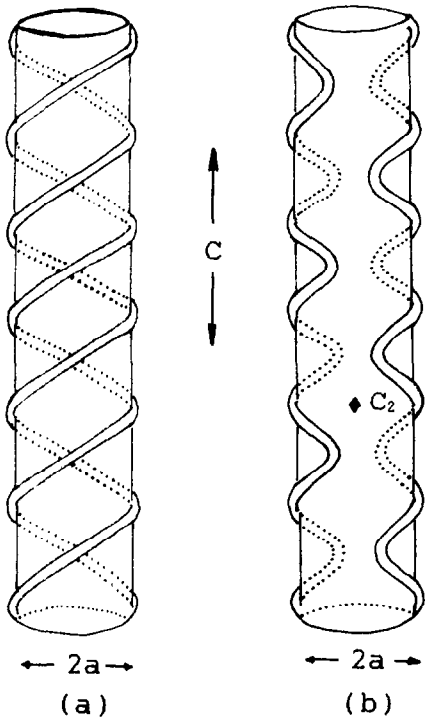

Fig. 2. (a) Fundamental Watson-Crick model, (b) Fundamental SBS structure. C = axis length of repeat unit; a = residues of phosphate strand; C_2 = double axis (perpendicular to paper)

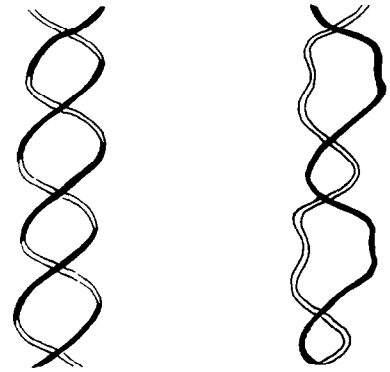

Fig. 3. CPK model (right) and WC model (left).

distribute randomly. But conformations of the nucleotide distribute randomly. In some cases, it matches up with the GG conformation for building a right-handed helix. In other cases, it matches up with the TG conformation for building a left-handed one.

With regard to helix and 'side by side' structures, the CPK model does not exclude interstrand twists, and there are no big twists in the model. When a helix changes into the 'side by side', bases will be in optimum positions for the replication, transcription, renaturation, chain hybridization and so on.

Now, DNA conformers have been at least classified into 3 families: A, B, Z. They can be converted to each other [5]. It means that right- and left-handed senses can also convert.

We consider it has certain theoretical significance to modify WC and CPK models by the *cis* ladder conformation. Consequently, we propose the new model of the DNA dynamic state shown in Fig. 4. The model may

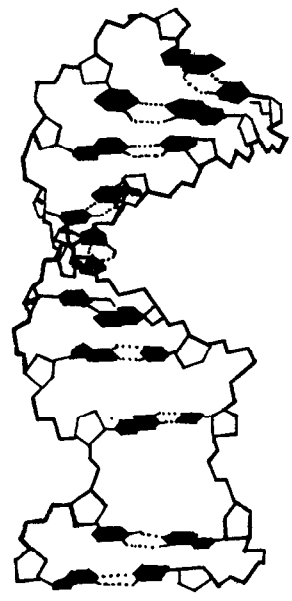

Fig. 4. DNA dynamic state model. WC double helix, modified by the *cis* ladder conformation is shown at the top. The modified CPK model is shown at the bottom. They may be converted to each other.

rationally expound the DNA replication, transcription, renaturation, hybridization, premelting, breach, etc.

REFERENCES

[1] Cyriax, B. and Gath, R. (1978) Naturwissenschaften 65, 106–108.
[2] Rodley, G.A., Scobie, R.S., Bates, R.H.T. and Lewitt, R.M. (1976) Proc. Natl. Acad. Sci. USA 73, 2959–2963.
[3] Sasisekharan, V., Pattabiraman, N. and Goutam, G. (1978) Proc. Natl. Acad. Sci. USA 75, 4092–4096.
[4] Crick, F.H.C., Wang, J.C. and Bauer, W.R. (1979) J. Mol. Biol. 129, 449–461.
[5] Jin, Z. (1983) Acta Scientiarum Naturalium Universitatis Jilinensis 3, 91–93.