

Life origination hydrate theory (LOH-Theory): the DNA monochirality nature

V.E. Ostrovskii (1), E.A. Kadyshevich (2), and A.V. Dzyabchenko (1)

(1) Karpov Institute of Physical Chemistry, Moscow, Russia (vostrov@cc.nifhi.ac.ru; adz@cc.nifhi.ac.ru), (2) Obukhov Institute of Atmospheric Physics RAS, Moscow, Russia (kadyshevich@mail.ru)

Abstract

The cause of the DNA monochirality is discussed in the literature from its discovering. In this work, the simple explanation for this phenomenon is given.

1. Introduction

It is well known that the molecules of a majority of chemical substances do not rotate the light polarization plane (LPP). Molecules of some chemical substances are capable of rotating the LPP to the right (D-enantiomers) or to the left (L-enantiomers). They are called “chiral molecules”. Among them, there are chemical substances whose molecules rotate the LPP, being in some definite aggregate state or in any definite aggregate state. DNA molecules rotate the LPP being in any aggregate state. The cause of chirality of any molecule is its asymmetry relative to a plane, axis, or center (most frequently, atom), its helical form, or the occurrence of the so-called topological bonds. In organic chemistry, the occurrence in a molecule of an asymmetric carbon atom is the most frequent but by no means unique cause of chirality (central chirality). In the cases, when a molecule has two or more causes to be the chiral one, the differentiation of the relative role of each of the factors is a difficult and, on frequent occasions, unsolvable task. In such cases, first, it is necessary to ascertain the occurrence of several sources of chirality in the molecule under consideration. If so, at the today level of science, this knowledge gives grounds to consider the chirality of such a molecule as a whole rather than the separate causes of its chirality. Usually, any differentiation of the summarized optical activity among its sources would be speculative. It is also necessary to take into account that different sources of chirality may reveal themselves differently in different aggregate states, under different temperatures, etc.

The chirality of DNA molecules is by no means striking, because the DNA double helixes have a spiral structure and because the desoxy-ribose

radicals entering the DNA molecules contain asymmetric carbon atoms. Biochemists believed that DNAs are produced by Nature from N-bases, phosphates, and desoxy-D-ribose and couldn't understand the way of the natural selection of just desoxy-D-ribose for DNA synthesis from the racemic mixture of desoxy-D- and desoxy-L-ribose, because the D- and L-enantiomers of desoxy-ribose can be synthesized only together and, usually, in almost equivalent quantities.

The cause of the DNA monochirality is not stated. There is the widely-distributed opinion that this riddle is credited with the problem of living matter origination (for example, [1]).

The LOH-Theory [2-7] allows a simple answer to the riddle of DNA monochirality.

2. The DNA monochirality nature

According to the theory, when DNAs are forming from CH₄ and nitrate- and phosphate-ions inside the hydrate structure, no riboses as such form. Indeed, when N-bases are being produced inside the hydrate large cavities from CH₄ and nitrate-ions, the excessive radicals are thrown out into the adjacent hydrate small cavities. Just the thermodynamic front governs formation of such a chemical substance which is capable of joining an N-base and two adjacent phosphate radicals on the basis of polycondensation reaction. This connecting radical is similar in its chemical composition to ribose, but it somewhat differs from ribose in its three-dimensional structure. Namely, the ribose-ring plane is twisted. This twisting leads to the occurrence of more than two asymmetric 4-substituted carbon atoms in the ribose-like radical. Just such a reconstruction of pentamerous rings leads to a change in the optical activity of DNA as compared to that of the free ribose molecules. In addition to the central chirality, a contribution of the DNA spiral twisting to the DNA optical activity cannot be excluded; it is known that

the propeller-like biphenyl molecules, where the benzene rings are turned to each other by 45 degrees, are chiral.

As an example, Figure shows the four-radical complex, which contains two phosphodiether, one deoxy-D-ribose, and one cytosine radicals. The complex is turned at such an angle that the projection of the ribose-like ring located in the center of the Figure is seen so close to the line as possible. It is seen that the ribose-like pentamerous ring is not plane. In the presentation, other examples will be also presented.

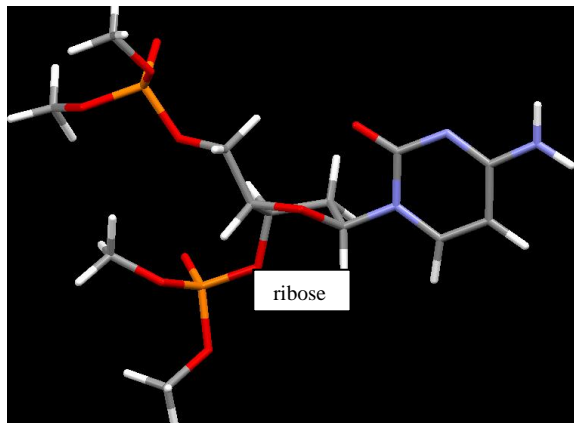


Figure: 3D scaled images (Mercury PC program) of the four-radical complex within the CH₄-hydrate structure; grey, violet, red, white, and yellow sticks are the atomic radii of C, N, O, H, and P atoms, respectively, the cross-points of two or more grey, violet, red, and yellow sticks are C, N, O, and P atomic nuclei, respectively, and the points of white stick connections with sticks of any other color are H-atom nuclei. The H₂O structure is removed.

The DNA formation process goes in Nature for a long time, and different rearrangements proceed repeatedly within the hydrate structure. We are not capable of viewing all of them and observe the final result only. Therefore, we cannot reproduce all rearrangements in time at different intra-hydrate compositions. Just the thermodynamic front performs this work.

In our opinion, the observable DNA optical activity is determined by the DNA molecules as a whole rather than by the intra-molecular ribose radicals as such; therewith, the occurrence of radicals of N-bases and phosphodiether radicals in the neighborhood of

ribose radicals is capable of influencing the DNA optical activity.

3. Conclusion

Thus, in our opinion, the actual DNA optical activity should be considered as some feature inherent in DNA and, apparently, there are no grounds in searching for the causes of this activity in any phenomena beyond the framework of chemistry or physical chemistry.

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