Dual Interpretation by de Broglie/ Schrödinger Waves of the Genes and Genetic Program of Organisms Assimilated to Cybernetic System with Orbital Automatic Self-organization

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Abstract

The automatically organized cybernetic system is a dynamic system with a large number of elements (atoms molecules) where there occurs an automatic process influencing the reciprocal relations between elements and their functions so that the complex can evolve toward ever more organized states with a view to obtaining certain properties or to fulfilling an objective-function.

The structure, functions and the entire cellular activity of an organism are determined by the biochemically codified genetic program in the nucleotides (genes) of dezoxyribonucleic acids (DNA) and ribonucleic acids (RNA).

In Schrödinger's theoretical formulation, the electron is no longer conceived as a punctiform structure on a certain orbit, but it takes up a space.

The electron forms a charge cloud with the nucleus in its centre, this charge cloud or spatial charge is interpreted as a space where there is a certain likelihood of electron localization. The electron is a material wave connected with the nucleus by its electric charge.

In this paper we give a dual interpretation by de Broglie (Schrödinger) waves to the genes and the genetic program of the organisms assimilated to cybernetic systems with automatic self-organization of the orbitals occupied by the electrons σ and π.

Keywords: cybernetic system, dual interpretation, nucleotides, genetic program, orbitals.

1 Cybernetic Systems, Undulatory Models, Nucleic Acids and Genetic Program Fundamentals

1.1 Defining Cybernetic Systems with Automatic Organization

Cybernetic systems with automatic organization are dynamic systems having a large number of elements (atoms, molecules) where there occurs an automatic process that influences the reciprocal relations between the elements and their functions so that the complex, the main part of the cybernetic systems, should evolve toward ever more organized states with a wiev to obtaining certain properties or to fulfilling objective – functions (Beneš, 1971).

A dynamic system is an ensemble of material elements, which act upon each other, being described as a large number of variables, which change in time and space.

The automatic organization is accomplished by means of certain operations (or combinations of these operations), which are:

- operation of modifying elements concentration;
- orientation operations;
- union operations;
- ordering operations;
- joining operations by forming new links;
- function ordering operations.

The first five operations refer to the complex form (structure, configuration).

The last two operations refer to the complex function.

1.2 The Undulatory Atomic Model, de Broglie Waves (Brenneke, 1966).

By analogy with the dualism wave corpuscle at light, de Broglie consideres that this dualism presents validity also for matter and therefore the particles possess also wave character.

The light quantums corresponding to an undulatory process with the wave length λ and frequence ν have an impulse:

$$mc = \frac{h\nu}{c} = \frac{h}{\lambda} \qquad (1)$$

in which: h – Plank's action quantum
c – light velocity

De Broglie attributes undulatory properties to a corpuscle, so that the material particle of mass (m) and velocity (v) corresponds to an undulatory process whose properties can be calculated from the relation:

$$mv = \frac{h}{\lambda} \qquad (2)$$

The wave length (λ) assigned to a material particle of impulse (mv) is called de Broglie wave length (material wave).

De Broglie extends the dualism between wave and corpuscle and shows that all bodies which possess an impulse (p) can be attributed a wave of length λ.

The phenomenon of de Broglie waves can be noticed only in the domain of bodies of atomic dimensions.

The electron cannot be conceived as a punctiform structure on a certain orbit, as it takes a space of the orbit diameter size grade.

The electron forms a charge cloud with the nucleus in the centre; this charge cloud or spatial change can be interpreted as a space where three is a certain likelihood of electron localization.

An atomic model which takes into account these representations has been developed by E. Schrödinger.

In Schrödinger’s theoretical statement the electron is a material wave connected with the nucleus by its electric charge.

The atomic model of wave mechanics describes the state wave of the electron in the atom by indicating nodal surfaces. The quantum numbers principal (n) orbital (azimuthal) (ℓ), magnetic (m) and spin (s) in connection with nodal surfaces have new significances.

The spatial electronic wave is a stationary wave if the wave length is contained by an integer in the orbit circumference, that is:

$$mc = \frac{h\gamma}{c} = \frac{h}{\lambda} \tag{3}$$

in which:

n – main quantum number;

r_n = quantum orbit radius;

v_n = electron velocity on orbit n;

m_e = electron mass.

Introducing in the equation de Broglie wave length (λ), Bohr’s condition is obtained:

$$2\pi \cdot r_n m_e v_n = nh \tag{4}$$

in which: $2\pi \cdot r_n$ - circular length trajectory

$m_e v_n$ - electron motion quantity.

De Broglie waves give information on the probability with which a particle will move on a certain trajectory.

If the wave amplitude, in a certain place of the space is great, then the probability for the particle to find itself in the respective place of the space is great.

According to Heisemberg’s uncertainty relation, the position (x) and the impulse (p) of the atomic particle cannot be determined simultaneously with an arbitrary accuracy.

1.3 Electrons Distribution in the Atomic Model of Bohr (Brenneke, Schuster, 1966).

a) *Principal quantum number n*

In the atomic model of Bohr, to every energetic state of the electron correspond a circular orbit.

Each energetic state belonging to a Bohr quantum number can be decomposed in thiner energetic levels. The quantum number introduced by Bohr constitutes the principal quantum number.

b) *The azimuthal quantum number (orbital) ℓ.*

An extension of Bohr atomic model was introduced by the theorist physicist A Sommerfeld, the modified model being called the atomic model Bohr – Sommerfeld.

In this model all the electrons from the same quantum principal number are considered as belonging from a layer (stratum), called as principal a layers which surrounds the nucleus.

The blankets corresponding to the quantum principal numbers n = 1, 2, 3, 4, 5, 6, 7 are called layers: K, L, M, N, O, P, Q.

After Sommerfeld the principal layers are grouped by a quantum auxiliary number ℓ, in another electronic states; so in every principal layer appears a number of small blankets.

The azimuthal quantum number on orbital (ℓ) characterizes the size of the kinetic moment had by an electron on certain orbit of the principal layer.

The different value of the kinetic moment is reflected in the shape of the electrons orbit that is all the electrons with the same quantum principal number, but with quantum azimuthal number different (ℓ), are mouved on elliptical orbits different.

In accordance with Sommerfeld's theory, the possibility of quantum azimuthal number variation in a principal layer is confined by the quantum principal number (n).

The quantum orbital (ℓ) can't be greater that the quantum principal number n minus one unit.

So, for ***n*** done, ℓ=0, 1, 2,…,n-1

If the quantum azimuthal number (ℓ) is equal with the quantum principal number (n) decreased with one, (ℓ = n-1), than an electron is on a circular orbit; this is a particular case of the elliptic orbit.

The limitation of the quantum orbital number (ℓ) by $0 \le \ell \le n-1$, conducts at the assertions:

- in layer K(n=1) there is a single quantum understate possible, ℓ=0; therefore in layer K exists only a circular orbit;
- in layer L (n=2) exists understates ℓ=1 and ℓ=0; therefore we have a circular orbit and an elliptic one;
- in layer M (n=3) exists quantum understates ℓ=2, ℓ=1, ℓ=0; for ℓ=2 we have a circular orbit and two elliptic orbits for ℓ=1 and ℓ=0.

The quantum understates characterized by the quantum numbers ℓ=0,1,2,3 are called and understates s, p, d, f.

To point out any electronic state it is specified the quantum principal number n =1, 2, 3,… followed by the letter which represents the quantum azimuthal number (ℓ); for example, an electron 2s is an electron which gravitates on an elliptical orbit (ℓ=0) in layer L.

c) The magnetic quantum number m

The electronic states characterized by the quantum principal and azimuthal numbers don't include any information about the orientation of the elliptic and circular orbits in space.

In a magnetic field the electronic orbits orientation in space is different. The orbit's surfaces can be perpendicularly, parallel or could be arbitrarily oriented in space.

The energetic states of an electron by applying a magnetic field are quantified, that is and for the spatial orientation of the orbits, exists a quantum magnetic number (m).

At a quantum azimuthal number (ℓ) done, the quantum magnetic number could be between - ℓ and + ℓ (integer values).

d) Quantum spin numbers s

By their rotation on a elliptic or circular orbit the electrons have a kinetic moment; in addition, by their rotation arround their axis appears a supplementary kinetic moment. His own electron’s rotation is called spin (rotation).

The impulse vector of this kind of rotation occupies in a magnetic field only two directions: one orientated on the direction and the sense of the magnetic field and another in contrary sense.

These energetic differences are specified by a quantum spin number (s) which can take the values $s = +\frac{1}{2}$ and $s = -\frac{1}{2}$.

The electronic configurations of the elements (atoms) which compose the cybernetic system: H, C, N, O and P are presented in table 1.

Table 1 – The electronic configurations of the elements (atoms).

The layer			K	L	M
Quantum principal and azimuthal number			1S	2s	2p
1	H	Hydrogen	1		
⋮	⋮	⋮	⋮	⋮	⋮
6	C	Charbon	2	2	2
7	N	Nitrogen	2	2	3
8	O	Oxygen	2	2	4
⋮	⋮	⋮	⋮	⋮	⋮
15	P	Phosphorus	2	2	6

The energetic states of electrons, atoms, from cybernetic system are presented in table 2.

Table 2. The energetic states of electrons

	K	L		M
n	1	2		
ℓ	0(s)	0(s)	1(p)	
m	0	0	-1, 0, +1	
s	$\pm\frac{1}{2}$	$\pm\frac{1}{2}$	$\pm\frac{1}{2}, \pm\frac{1}{2}, \pm\frac{1}{2}$	
Possible states	2	2	6	
Total number	2		8	

1.4 The Electrons Distributions in the Undulatory Model (Brenneke 1966)

The Schrödinger and Heisenberg theory assessment, conducts to the atomic intuitive models, which allow a figurative representation of the distribution charge (spatial charge) in atomic cover.

The existence of crucial surfaces which bind the points where the probability to find electrons is null can be observed in these models.

The crucial surfaces separate the regions where the electrons are ordered in spatial charge, that is where the Broglie waves amplitude are extremely big.In the atomic model of Schrödinger from the ondulatory mechanics, the electrons in fundamental state 1s forme a spherical charge, which decreases slowly in density toward exterior.

In the 2s state the electrons cloud is underdivided in two layers by a spherical layers. The 2s electron there is in a law probability in a spherical space from the nucleus neighbourhood and in a high probability in an exterior space of crucial surface which has a spherical layer shape (figure 1).

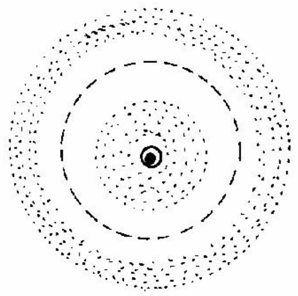


Fig.1. The 2s electron

To the 3s state corresponds two spherical layers upon an interior sphere and to the ns state corresponds (n-1) spherical layers upon an interior sphere.

Similar to, exists here two (respectively n -1) crucial spherical surfaces where the Broglie amplitude wave takes the null value.

In a 2p state, the spatial charge of the electron consists of two parts, two oval halfs separated by a crucial plane. The both spatial charges are disposed with symmetrical rotation given by the normal to this plane (figure 2).

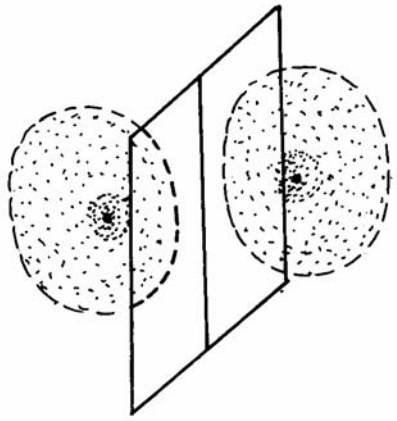


Fig.2. The 2p electron

In the case of 3d electron which quantum magnetic number m=0, the nodal surface where charge density becomes null, it is a double cone. The spatial charge of the electron divides in two spheres and a ring in the cove’s tip neighbourhood.

At an 3d electron with quantum magnetic number $m \neq 0$, the spatial charge of the electron consists of four parts almost identical separated by two planes where the charge density becomes null.

In general, the special charges of the electrons could be classified after their type and the crucial surfaces where the Broglie amplitude wave value is null. The crucial surfaces are spherical, plane and conical.

The type and the number of the crucial surfaces are determined by their quantum state that is by the first three quantum numbers of the electron.

1.5 Hybrid Orbitals ot he Carbon Atom. Bound σ and π (Berai 1973, Bransden 1980).

The electron's motion on orbit, around his nucleus generates an ondulatory phenomenon characterized by the appearance of stationary tridimensional wave, which defines the atomic orbital.

Quantum mechanics is based on the principle that the elementary particles (electrons) have a character as well particles as waves a dualism expressed by the Broglie's relation:

$$\lambda = \frac{h}{m \cdot v} \tag{5}$$

As a consequence of this new interpretation manner, the classical mouvements relations are replaced by wave equation of F. Schrödinger.

The wave function ψ, or one's own functions are called also orbital wave function or simple, orbital.

For an electron the square module value of wave function $|\psi|^2$ in a done point in space is interpreted as the charge's density in that points called the density of probability; in this point the electron is considered extended in a negative electricity could with variable density from place to place.

In the fundamental state the carbon atom has the electronic density $1s^2 2s^2 2p_x^1 2p_y^1$

After an activation determined by an exterior action, an 2s electron is transferred in a 2p orbital, his electron configuration becoming $1s^2 2s^1 2p_x^1 2p_y^1 2p_z^1$, where p_x, p_y and p_z represents the orbitals.

By the electron transition $2s \rightarrow 2p$ eah electron from stratum n=2 occupies an orbital called hybrid orbital.

To the carbon atom are important the hybridizations sp^3 and sp^2 regarding the dual interpretation of genes and of genetic programme. When by interpenetrating 2s orbital with the three 2p orbitals are obtained four equivalent orbitals (by the equalization of energetic levels), than the hybridization is sp^3 type. The sp^3 orbitals are occupied by an electron, so called σ electron.

When 2s orbital interpenetrades only two of three 2p orbitals ($2p_x$ and $2p_y$), than results three equivalent hybrid orbitals sp^2; the third orbital $2p_z$ rests unmodified. sp^2

orbitals are occupied by an σ electron; the orbitals are disposed triangularly in the same plane and forms between they angles of 120^o (figure 3).

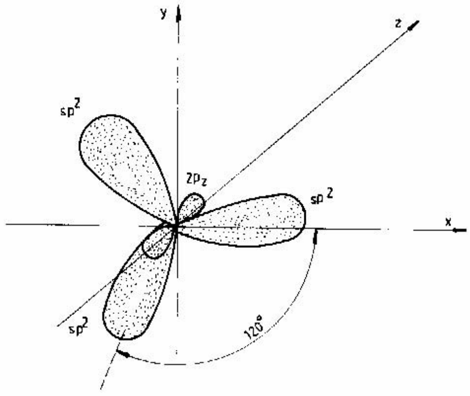


Fig.3. The dispozition of the three hybrid orbitals sp^2 and of the non-hybridized orbitals $2p_z$

2p orbital non-hybridized is perpendicularly above and under this plane; he is occupied with an electron, called electron π. The hybridization sp^2 is commonly to the carbon combinations which has a double bound.

To form a covalent bound, each from the participated atoms must to have an orbital occupied by a single electron (uncompled) these two electrons must being with opposite spin; the resulted molecular orbital is occupied by two electrons with antiparallel spin, having two nuclei.

The covalent bounds, by which the carbon atom can link up with the atoms of other elements or with other carbon atoms, are of two types: σ bounds and π ones.

These bounds are made up as a consequence of different hybridization possibilities of the carbon atom in an activated state; that means that they are different and impose to the molecules some chemical characteristics.

The σ bound is made by the carbon atom in tetragonal valence state (hybridization sp^3).

For example the C-H bound orbital resulting from the interpenetration of a hybrid orbital sp^3 occupied by an electron σ, with a 1s spherical orbital; this orbital shows rotation symmetry to the axis linking the nuclei of the two bound atom. The C-C bound are made in a similarly way.

The π bound is present to the compounds with multiple (double) bonds.

The double bound to the carbon atoms is explained by the tetragonal valence state in which they manifest sp^2 hybridization. Through the three hybrid orbital sp^2, the carbon atoms link up with two hydrogen atoms (C-H bounds) as well as between themselves (C-C bounds). All these are σ bounds.

The four-th bound from the carbon atom is made by the interpenetration of 2p orbitals, non-hybridization from each carbon atom. The bound orbital is occupied with two electrons with opposite spin (π electrons), making π bound.

The double bound is formed of a bound σ and a bound π. Owing to the form and position of the hybrid orbitals sp^2, the two carbon atoms and four hydrogen atoms are found in a plane, the angle between the bounds being 120 degrees. The orbitals $2p_z$ are perpendicular on the plane of the links σ. The linking orbital resulting from their interpenetration is made up of two parts that are in a plane perpendicular on the plane of the bounds σ, above and below it; the electronic density of the bound π is null at the planes intersection.

As the bilobular shape of the orbitals p does not allow an interpenetration as profound as that of the hybridized orbitals, the bound π is less stable than the bound σ. Because of the electronic density of the bound π, above and below the bonds σ plane, the free rotation round the axis C-C can no longer take place; a rotation of two halves of molecules distorts the electronic cloud π, diminishing the molecule stability.

The bound π is less polarizable than bound σ (figure 4).

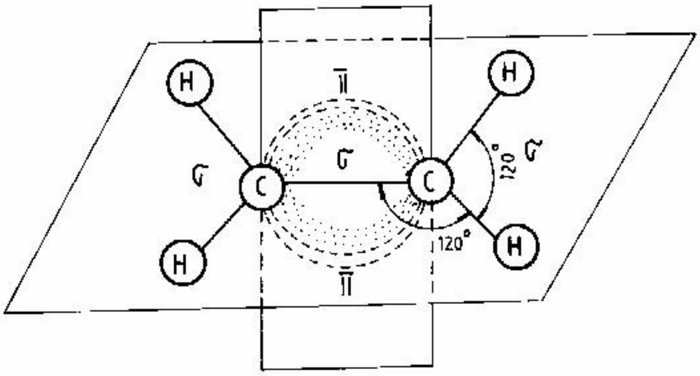


Fig.4. The formation of double bond between the two atoms

1.6 The Nucleic Acids (DNA and RNA). The Genetic Programme (Raicu 1979 and Stănescu, 1977)

The alive matter is organized is cells and the live take place in organisms with cellular structure.

The structure, the functions and the whole cellular activity are defined by the genetic programme biochemical wrote down in the desoxyribonucleic acid (DNA) from chromosome.

Specific for all the cells is that they have a genetic programme where there is biochemical codified the information so necessary to achieve their structure and functions.

The superior organisms, the cell with nucleus (euchariotes) include a bigger quantity of genetic informations, a bigger genetic programme, comparing with the cells without nucleus (prochariotes).

The biological molecular research proved that all the cells have the same registration system of the genetic informations.

The different characteristics morphophysilogical and biochemical of organisms are established hereditary by the genes from chromosome. All these genes form the genetic programme.

By studying the DNA structure, J.Watson and F. Crick identified the atoms position and the composition of DNA macromolecules (Stănescu 1977).

The nucleic acids are macromolecular substances consisting of simple structural units called nucleotides.

Each nucleotide is made up of a nitrogenous base a sugar and a phosphoric radical (Miriță 2001, Berai 1973).

The nitrogeneous bases from the nucleic acids macromolecule are two types: purinic and pyrimidinic; these two types result from a common nucleus called purine and respectively pyrimidine derived from benzene ring (figure 5 and figure 6).

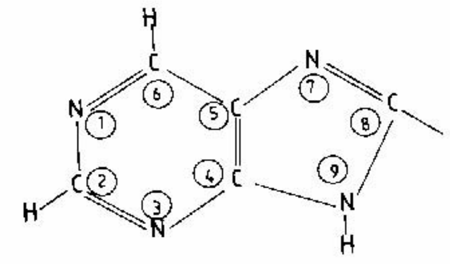


Fig. 5. The purinic nucleus

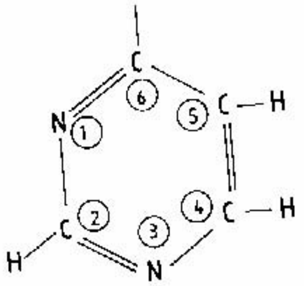
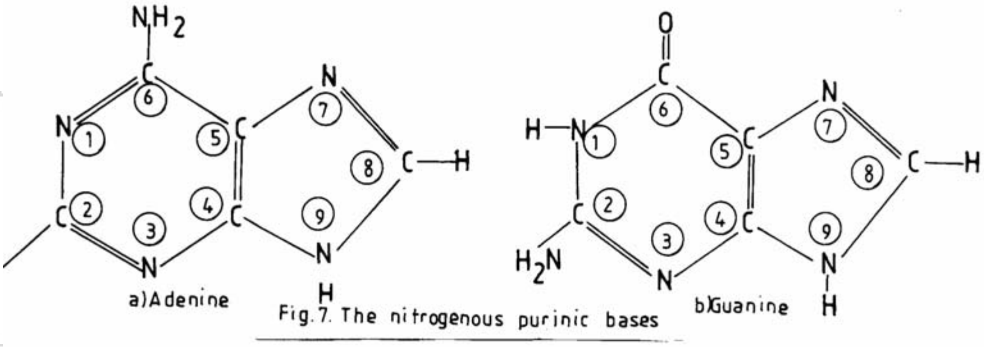


Fig.6 The pyrimidinic nucleus

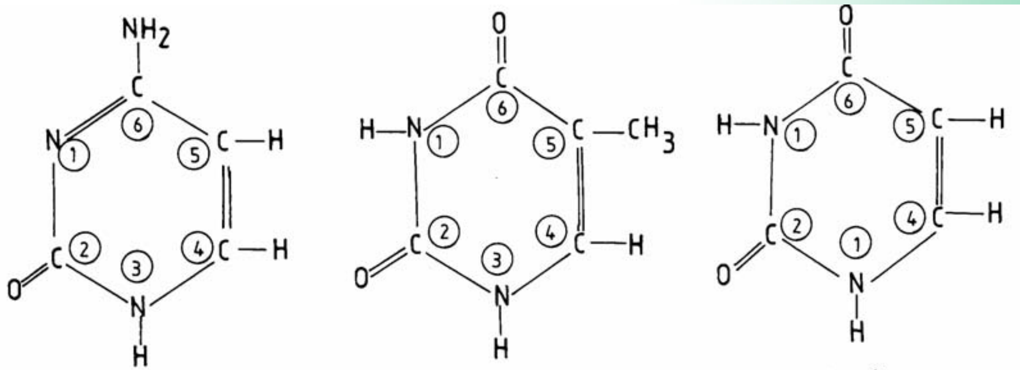
The nitrogenous bases from DNA are: adenine and guanine (figure 7) and those pyrimidinic are cytosine and thymine; in RNA acid, the thymine is replaced by another base called uracil (figure 8).



a)Adenine

b)Guanine

Fig. 7. The nitrogenous purinic bases



a) Citosine b) Thimine c) Uracil

Fig.8 The nitrogenous pyrimidinic bases

The research of J. Watson and F. Crick point out that the DNA macromolecules are formed by polinucleotides chains parallel disposed and wrapped helicoidal around an axis; a chain has an ascendent direction and another chain has a descendent one.

Contrary to RNA acid which is formed from a single polinucleotide chain, DNA has two parallel chains linked by two bases: one purinic and another pyrimidinic.

In DNA macromolecule exists four link types: adenine-thymine, thymine-adenine, guanine-cytosine and cytosine-guanine (Raicu 1979).

Having so structure, those two polinucleotide chains of DNA are complementary because by the alternation order of nucleotide in a chain depends the nucleotides order in another.

The purinic and pyrimidinic bases are binded by a hydrogen bound which assure the stability and the cohesion of DNA.

By modifying of snapshot of the four nucleotides types it can be register a big quantity of genetic informations. So, to a snapshot of 3 nucleotides called codon from DNA macromolecule correspondens an aminoacid.

Being 4 nitrogenous bases types it could be achieved 4^3 codons therefore 64 combinations of 3 nucleotides which is the genetic code.

The gene could be defined as a part from macromolecule DNA, formed by identic codons with the aminoacides number; the gene includes the biochemical codification of the genetic information so necessary to the polipeptidic chain.

2 The Interpretation of Broglie/Scrödinger by Waves of Structural Units of DNA and RNA Assimilated with Cybernetic Systems with Automatic Self-Organization of Orbitals Occupied by σ and π Electrons

In paper, the structural units of the nucleid acids DNA and RNA, called nucleotides, made-up from a nitrogeneous base, a desoxyribose molecule and a phosphorous rest, are assimilated with cybernetic systems with automatic self-organization.

The nitrogenous bases are made-up from two nucleus types: pyrimidinic and purinic.

The pyrimidinic nucleus is an aromatic heterocicle formed by 2 nitrogen atoms (N) and 4 carbon atoms (C) (figure 6).

The purinic nucleus is a double hetherocicle made-up from 4 nitrogen atoms (N) and 5 carbon atoms (C) (figure 5).

From pyrimidinic nucleus derived the nitrogenous bases pyrimidinic: uracil (U), thymine (T) and cytosine (C) (figure 8).

From purinic nucleus derived the nitrogenous bases purinic: adenine (A) and guanine (G) (figure 7).

Analyzing the nitrogenous bases pyrimidinic and purinic we can see that they are made-up from the next chemical elements: H, C, N, O and respectively phosphorous (P) in the nucleotides components.

Assimilating the nucleotides with cybernetic systems with automatic self-organization, as dynamic systems with a light number of elements, the complex cybernetic system is made-up from the elements H, C, N, O and P (Table 1).

Between these elements take place an automatic process of autonomous organization with influence of reciprocal relations and of functions of these elements; so this complex develops toward states more organized with the achievement of one function: the stoking of genetic information with nucleotides formation, components of the genetic programme.

From pyrimidinic and purinic nucleus study results the basis elements which is: H, C and N with the properties from table 1 (the layers K and L and quantum and azymuthal principal numbers: 1s, 2s and 2p).

From the analyse of pyrimidinic bases: uracil (U), tymine (T), cytosine (C) - figure 8 and purinic bases: adenine (A) and guanine (figure 7) result the component elements: H, C, N and O with the properties from table 1.

In the structure of nucleotides near the nitrogenous base, phentose, appears and the phosphorous radical, respectively near the elements: H, N, C, O appears the phosphorous (P) (table) (Miriță 2001).

The values of quantum numbers: principal (n), orbital (ℓ), magnetic (m) and of spin (s) corresponding to the layers, K and L also the energetic states of elements electrons, components of the nucleotides, are presented in table 2.

The component elements of the complex (gene/nucleotide) formed by the atoms of elements H, C, N, O and P, action just the layers K and L with quantum numbers principal and orbital: 1s, 2s and 2p (table 1).

In the atomic model of Schrödinger, the electrons in the fundamental state 1s, forms o spatial charge spherical.

In 2s sate, the cloud of electrons is subdivided in two parts, by a spherical layer where the amplitude of Broglie wave take the null value (figure 1).

In 2p state, the spatial charge of the electron cousist of two halves separated by a model plane (figure 2).

Analizyng the pyrimidinic and purinic bases which come in nucleic acids componence: uracil (U), thymine (T), cytosine (C) adenine (A) and guanine (G), figure 8 and figure 7) we can observe the alternance of simple links with double links of carbon atoms (C), nitrogen (N) and oxygen (O).

The undulatory interpretation by Broglie (Schrödinger) waves point out that an electron 2s is promoted in a 2p orbital the electronic configuration of the carbon atom, becoming: $1s^2 2s^1 2p_x^1 2p_y^1 2p_z^1$.

The resulted orbitals one called hybridized orbitals with the electronic cloud density modified comparatively with an orbital unhibrided (Berau, 1973).

To the carbon atom (C) are very important the hybridizations sp^3 and sp^2. The sp^3 orbitals are occupied by an electron σ.

The sp^2 orbitals are occupied by an electron σ, with trigonal amplacement in the same plane forming between them anglos of 120 degrees (figure 3).

The 2p orbital unhybrized is perpendicularly bellow and above to this plane ocupyed with an electron π (figure 4).

We find the hybridization sp^2 to the carbon combination which contain a double link.

Analyzing the configuration of two nucleus: pyrimidinic (figure 6) and purinic (figure 5) we can observe the alternance of simple with double links of carbonj atom (C) at 120^o. In the case of double bounded the sp^2 orbitals by σ electrons trigonal arranged in the some plane at 120^o and the 2p orbital, unhybridized is perpendicularly and is occupied by an electron π.

In the pyrimidinic and purinic nucleus, we observe that 2p orbitals, occupied by π electrons are arranged also to 120^o.

From here we conclude that exists an autonome organization of orbitals occupied with σ and π electrons a symmetric configuration in both planes: horizontal and vertical (fig.4).

The Broglie waves in the pyrimidinic and purinic nucleus of elements electrons are composed resulting o stationary tridimensional outlined wave of nucleus, which is a driving wave, possible life wave.

Conclusions

The structural units of DNA and RNA (nucleotides/genes) are made up in cybernetic systems with autonomous automatic self-organization.

The complex of cybernetic system is formed by the lost of atoms of elements: H, C, N, O and P.

The pyrimidinic and purinic nucleus and their derivates: uracil (U), thymine (T), cytosine (C), adenine (A) and guanine (G) are made up by an automatic self-organization of orbitals occupied with σ and π electrons of the atom of elements H, C, N, O and P.

Automatic, autonomous self-composing of Broglie waves/Scrodinger of elements which compose the pyrimidinic and purinic nucleus conducts to the forming of stationary tridimensional outlined wave which could be the driving life wave.

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