

**About physical nature of the biological field.
Torsion model of a cell (hypothesis).
O.G. Gavrish**

***Our definition of the main feature of the biological field
does not have in its contents any analogue
with the fields known to physics (although, of course,
it does not contradict them).***
A. G. Gurvich.

Principles of analytical biology and cell fields theory.

The initial variant of the hypothesis about physical nature of the biological field was published as an annex to monographs [11, 12], in a magazine variant - [13] and also given as a report on the conference "Physics of biological systems" [14]. This article is the further development of ideas about the nature of the biological field.

I.

The modern biology paradoxically ignores the fundamental principle of the nature structure - its essential integrity. This caused a deep crisis in both the biological science and the spheres which try to depend on biology in their functioning. In particular, in medicine. Excessive use of analytical methodologies, especially on cellular and sub-cellular research levels, resulted in practically complete neglect of integral approaches. Although for about 150 years we understand that the cell is a morphological, functional and hereditary unit of living substance, the absence of the idea about the cell as a whole has been characteristic for biological science until these days. Nevertheless, many scientists of the XX century profoundly developed the ideas of the holistic ideology in biology in their works. Professor A. G. Gurvich (1874-1954) is undoubtedly one of them. In his works he puts the deep understanding of living manifestations integrity. In this context his theory of the biological field [1] deserves the special attention. Let us dwell on the principal moments of cell fields conception - the latest A. G. Gurvich's ideas about the biological field.

1. A.G. Gurvich associated the field source with the cell center - nucleus, lately - with the chromatin [2].
2. According to his ideas, the cell field has the vectorial and not force character. This notion is proved by the fact that molecules (molecular complexes) acquire new orientation, change their form or move in the field using the potential energy they accumulated participating in the cellular metabolism and not at the expense of the field energy. A molecule possessing excess energy is in the excited state and is liable to the field influence. At the same time a significant part of the accumulated energy turns into kinetic one. When this excess energy is used, and the molecule returns to the nonexcited state, it is not influenced by the field any more.
3. The cell field being a result of nonequilibrium processes is dynamic by its nature.
4. The cell field is anisotropic and specific.

The last years have seen a constant increase of interest to A. G. Gurvich's works. Unfortunately, this interest is mainly of superficial character and often leads to the distortion of his ideas, some authors even arrogate their own thoughts to him. For example, this is the only explanation to the appearance of the idea circulating in scientific and popular scientific literature and allegedly being suggested by Gurvich that cell fields are the ones generated by the cell (chromosomes) of photons. In this connection we should state that A. G. Gurvich did not reduce biological field manifestation to mitogenetic radiation [3], which he had studied for more than thirty years. Moreover, he examined this idea in his final work, however rejecting it [2, p.164]. Having profound knowledge in physics, Gurvich understood clearly that any of the fields known at that time did not correspond to the properties of the field discovered by him and did not consider it possible to speculate on this topic.

There is also the terminological aspect concerning the accurate use of notions. About 15-20 years ago L. V. Belousov proposed not to use the term "biofield" for the conceptions developed by Gurvich. There are at least two reasons for this. Firstly, Gurvich himself used exceptionally the term "biological field" in his works. Secondly, A. G. Gurvich substantiated the term "biological field" with strict scientific definitions and logical structures, in contrast to an indistinct notion "biofield", which is used for various fields that exist in alive systems and frequently used in declarative way.

More than 50 year have passed since A. Gurvich developed the conceptions about a biological field. For the last 15 years the principles of the "fifth" physical interaction - the field of momentum - have been theoretically formulated and experimentally proved. It is determined that fields of momentum are the essence of the field of rotation - torsion fields [4,5]. Torsion fields properties (in particular, energy, vectorial, axial character of their manifestation) astonishingly coincide with the properties of cell fields discovered by A. G. Gurvich. This work tries to formulate a simple model of a cell on the basis of ideas about a defining role of torsion interactions in the biological field realization.

II.

Properties of cellular structure elements and torsion fields.

1. Chromatin. Chromatin, which basis is the chromosomal DNA interacting with numerous proteins as well as RNA, has clearly defined periodic rhythm. The regular periodicity property of a natural process is evidence that it is an integral phenomenon. Indeed, rhythm of chromatin transformations on the next organizational level determines the cellular cycle from a division to division for fissionable cells and more specialized cycles for differentiated cells which do not fission.

The principles of chromatin molecular organization are highly important for us. It is well known that DNA forms spiral structures. Proteins in chromatin factually "control" the molecular complex organization ensuring its dynamics. Since a spiral structure is a key element in the structure of the chromatin on all levels of its organization, elements of rotatory movement are necessarily present in any dynamic transformations of the chromatin. Such transformations constantly occur during the entire cellular cycle - replication of a chromosomal DNA, genes transcription, and principle rearrangement of chromosomes during mitosis.

One of the important consequences of the physical vacuum theory [4] is the statement that any object polarizes vacuum and in that way creates in space a definite field structure possessing a torsion component. In other words, any object, except other fields, creates a torsion field around itself. Naturally, molecules and submolecular formations are not exceptions in these terms.

If a molecule or submolecular formation has the property to be in characteristic rotatory motion, then it is quite probably that it is a source of dynamic molecular torsion fields. It is important for us that every chromosome is unique in its structure. Moreover, in a specific space region - inside its cell - any individual chromosome is practically unique. This is a prerequisite of the fact that the fields generated by every chromosome during its motion express its properties in all their completeness and are not averaged.

2. Ion channels in the nuclear membrane and in the external plasma membrane.

As we know, ions have a definite spin. Ion channels ensure purposeful movement of ions, i.e. spinning objects, through a membrane. Every kind of ion channels is specific, i.e. ions of generally one kind and mainly in one direction move in it. Moreover, the important role of spiral structures of protein and nonprotein nature in the formation of transmembrane channels is well known [6]. Thus, there is a chance that the structural organization of membrane ion channels can ensure ion selection in accordance with their spin orientation as well as promote the acquisition of additional angular momentum by an ion.

It should be mentioned once more that the principles of spiral organization are widely used in the structure of biological macromolecules. They are exclusive for nucleic acids and important for proteins structure.

3. Protein molecules - ferments.

As everybody knows, ferments and their substrates participating in biochemical processes have property to acquire spin polarization and pass to the excited state. This property is widely used in EPR-research (electronic paramagnetic resonance) in biology and medicine. It seems really important that these are protein molecules that are the object of biological field action, according to A. G. Gurvich's opinion. These are they that being in the biological field action create "nonequilibrium molecular constellations" - the most significant dynamic formations in a cell. These are protein molecules-ferments that are the source of mitogenetic radiation - secondary chemiluminescence - the phenomenon which role is described below.

4. Mitogenetic radiation [3] is a superweak ultra-violet radiation in the 190-300 nm range. It was discovered by A. G. Gurvich in 1923. The exceptional importance of the mitogenetic radiation for animate systems was shown in numerous Gurvich's works in the 20s - 40s of the last century. Being of photon nature, the mitogenetic radiation has a torsion component [4]. It is an integral, addition (according to N. Bor) constituent of a cell field, however, in no way exhausting its manifestation. It is important to emphasize that the mitogenetic radiation plays an important role in both intracellular and intercellular interactions.

Sources of torsion fields in the external environment and their interaction with the cell torsion fields.

Surrounding cells and inanimate objects. The surrounding cells take part in the formation of an actual biological field of a given cell. External torsion influences on a cell are quite extensive and various. Among the inanimate objects we should emphasize the role of the water and substances dissolved in it generating very mobile dynamic system capable to transfer information vitally important for animate cells. The water due to its unique properties, speaking figuratively, constantly feels the breath of the Universe. Its rhythms and field interactions influence biosphere processes mainly via the water.

The crystalline structures constituting the biogeocenosis (for example, rocks) and organisms and closely interacting with the living matter play an important role. For example, clamshells, inorganic

crystalline structures in bone tissue, etc. contribute with static torsion fields.

III.

Peculiarities of DNA composition and functioning in respect to its supposed torsion features.

There are all reasons to believe that unique and specific DNA molecules, which are a part of chromosomes (chromatin), plasmids, and viruses, play a key role in the appearance, development and existence of life. DNA in animate organisms, being practically always in a complex with proteins, exists mainly in a form of variously organized spirals. Let us state some important properties of spirals.

A spinning object usually creates polarization near the poles along the axis of rotation, this polarization corresponding to the torsion fields of different directions. Correspondingly, the torsion field generated near one pole is the right one, near the second pole - the left one (see Fig. 1).

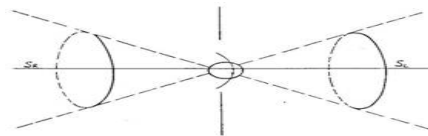


Fig.1

Fig. 1. The illustration from the work [5] showing the direction of the torsion field of an object with a spin.

The axial character of the field is obvious - the polarization occurs in the spacial cones located along the axis of rotation of an object.

Another situation occurs in the case of coiling-uncoiling of a spiral. The spiral during its coiling as well as during its uncoiling has the same rotation direction on its both ends. Naturally, a torsion field generated by a dynamic spiral in both directions will be the same (!), while the space polarization direction - "right-left" - will depend on whether the spiral is coiling or uncoiling (Fig.2).

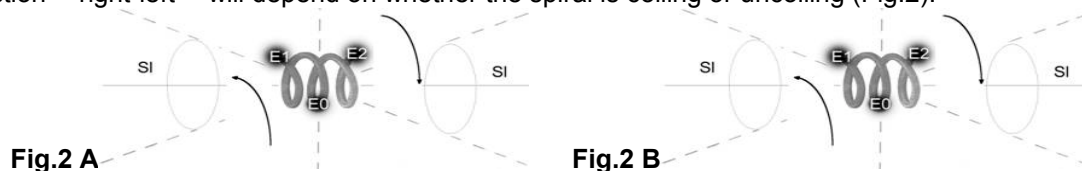


Fig.2 A

Fig.2 B

Fig.2. The torsion fields generated during the uncoiling of the spiral (A) and its coiling (B).

A - during the uncoiling of the right spiral the rotation of E1 and E2 elements with respect to the central area of the spiral (E0) polarizes equally the space in both external cones creating the right torsion fields.

B - during the coiling of the right spiral the rotation of E1 and E2 elements with respect to the central area of the spiral (E0) occurs in the opposite direction than during the uncoiling, and in this case the space in both external cones polarizes creating the left torsion field.

DNA unwinds completely in the process of replication (doubling), although not the whole at once. It is considered that the process of complete spiralization of chromosomes occurs in the initial stage of mitosis - in prophase. As we will see below, the spiralization (becoming compact) of chromosomes is apparently fully completed by the beginning of metaphase. Nevertheless, at the end of prophase the chromosomes of a dividing cell can be observed in an electron microscope. During the spiralization of chromosomes the torsion field has the direction which collides with the torsion field of the nuclear membrane. As a result, the cell nucleus disappears by the end of prophase, and chromosomes appear to be in the cytoplasm. With metaphase completed, the chromosomes begin to migrate to the poles of a dividing cell, and to all appearances, the processes of chromosomes despiralization starts. However, there are some reasons to consider (see part 5) that this is the despiralization of chromosomes beginning in metaphase that is a reason of the beginning of their migration to the poles. In telophase the chromosomes having accumulated near the poles of a dividing cell actively experience the despiralization restoring the previous orientation of the torsion field. This results in the formation of a membrane of a new cell of each daughter cells around the compact area of the chromosomes experiencing despiralization in telophase.

It is very likely that definite rotation movements associated with the unwinding and winding of DNA helix structures occurs as well during the genes transcription, although they evidently do not play a decisive role in the formation of a cell field. It should be stated that the process of replication as well as other processes in the cell are highly ordered and repetitive. As it is shown on the *Xenopus* (frog) eggs extracts in the work [7], eukaryotes experience the formation of compound protein complexes, so-called pre-replication centers (Fig. 3), immediately after the completion of division and the beginning of nucleus formation. Later they transform into replication centers, which define places of chromosome DNA fastening in a cell nucleus and in essence fulfill the replication in the S-period of interphase. There is logic in the supposition that replication centers are situated in a nucleus according

to the law, and their oscillation has a species-specific character. In this way one can define a specific peculiarity of a configuration of generated torsion fields, in other words, specificity of the biological field of a given type of a cell, tissue, and species.

Fig. 3. Visualization of the pre-replication centers in the *Xenopus* eggs extracts, photographs from the work [7]

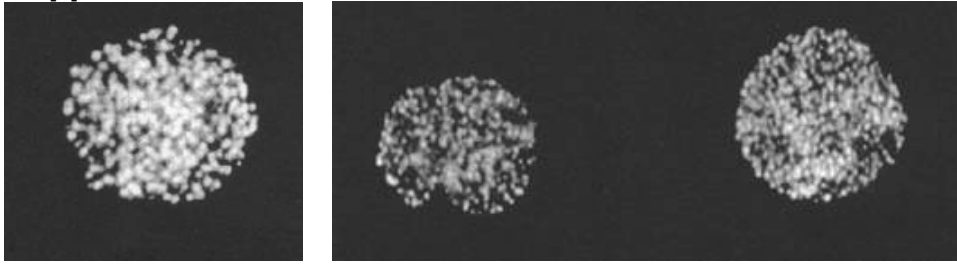


Fig. 3

The pre-replication centers are compound protein complexes that appear after the completion of mitosis by self-assembling. They transform into functional replication centers after the formation of the nuclear membrane. In the work [7] the pre-replication centers were visualized with the help of monoclonal antibodies with fluorescence mark.

A double spiral does not uncoil completely at once, but the uncoiling and replication of definite DNA segments called replicons take place. The replication may occur in several replicons simultaneously. The synthesis of DNA complimentary threads inside a replicative fork proceeds simultaneously with the despiralization of a double spiral.

The movement rate of the replicative fork of bacteria is known. For *E. coli* it is 800 pairs per second [6, p. 408]. Consequently, nucleotides of an uncoiling chromosome of *colibacillus* rotate around the axis of a double spiral with a minimum frequency of 80 Hz. At the same time the replication of an *E. coli* chromosome completes in 40 minutes. This process is longer for the majority of cells. However, there are some cells, including eukaryotic ones, whose replication passes much faster.

The principle moment in this reasoning is the fact that every chromosome in a cell and, correspondingly, every DNA molecule forming it is unique. (Of course, except polyploids, whose number of chromosomes is multiple. This however does not influence the character of a biological field of a polyploid cell to some extent, because multiple chromosomes are isomorphic in their structure, spatially close and similarly situated). After the doubling in the S-period of metaphase, sister chromatids still constitute the whole till the end of metaphase when chromosomes begin to migrate towards the pole of a dividing cell. However, after chromatids divided and spatially accumulated near the opposite poles, the cell cannot preserve itself as the whole any more, and in telophase the formation of two newly appeared cells is accomplished.

Therefore:

- DNA, its structural elements possess a (static) torsion field;
- The typical property of DNA structural elements is an ordered rotatory movement with a define frequency conditioned by a spiral principle of nucleic acid organization and realized in the processes of chromatin spiralization-despiralization.

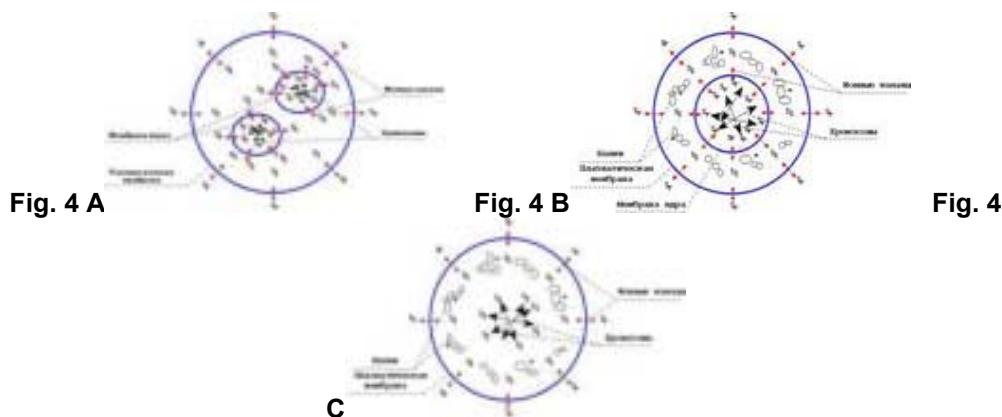
On the bases of above said, we can make a supposition that DNA molecules, which are the basis of the chromatin, in the process of their functioning generate specific torsion fields, which play a key role in the existence of all living substances.

IV.

A torsion model of a cell.

A phenomenological torsion model of an animate cell can be formulated on the basis of its above-mentioned properties.

A model of cellular torsion interactions must include sources of intercellular torsion fields of proper biological nature and elements sensitive to the influence of such fields, in our case, first of all - protein molecules-ferments.



A self-coordinated dynamic field created by a chromosomes assembly (Fig. 4 and 5) plays a determinative role in the formation of a cell torsion field. (As we know [4, 5], torsion fields of the same orientation attract each other, ones of the opposite direction - repel.) The complex torsion fields associated with the nuclear membrane and external plasma membrane and generated by functioning ion channels play a subordinate role. The ion channels of an external plasma membrane can acquire an independent significance in nuclear-free cells - for example, in mature erythrocytes. Thus, the source of the torsion field in a cell - chromosomes and membrane ion channels form a concentric system of imbedded fields. In its action area inside and near a cell there are protein molecules - ferments (and probably other molecules) which are in excited state. Protein macromolecules pass into excited state acquiring spin polarization when they experience biochemical transformation. Having got into the action area of a cellular torsion field, molecules transform, change their form, orientation spending excess energy obtained from chemical reactions. Molecules form intercellular dynamic structures peculiar to an animate cell during the interaction with a field. Having spent their excess energy and transformed into nonexcited state, molecules are not influenced any more by the cellular torsion (biological) field. Since the dynamics of the chromatin is different in various periods of the cellular cycle, we need to consider at least four different periods: chromosomes despiralization in telophase of mitosis; the phase of relative rest of the chromatin in the G1 period of interphase, chromosomes spiraling in prophase of mitosis, and chromosomal rearrangement during mitosis (see part 5).

1. After the end of short period of metaphase chromosomes begin their migration to the cellular poles. At the same time it should be mentioned that this happens irrespective of whether the chromatin spindle in a cell is present or absent. There are reasons to believe that the beginning of chromosome migration towards the poles is concerned with the beginning of chromosomes uncoiling - despiralization. We will dwell on this in more details in the next part, and now we will note that chromosomes uncoiling accompanies the stages of anaphase and telophase till the end of the latter. The despiralization is most intensive and full in telophase (Fig. 4 A). At the same time uncoiling chromosomes form near the poles (regions where they are compactly arranged by the end of telophase) a "right" torsion field, which collides with an internal "left" field of the plasma membrane generated by the functioning ion channels. The "right" and "left" torsion fields become balanced on a definite distance and in those places membranes of sister cells nuclei are formed. Thus, as a result of interaction and balancing of torsion fields, there is the realization of the well-known law which reads about the existence of a definite proportion between the nucleus volume and the total volume of a given cell type (Fig. 4 B).

2. The active chromosomes spiraling (becoming compact) occurs in prophase of mitosis (Fig. 4 B). In the confined space a "left" torsion field is generated, it collides with a "right" torsion field of closely located internal nuclear membrane. As a result the nuclear membrane is destroyed and "resolves" in the cytoplasm. The chromosomes, which are compact, visible in an electron microscope, appear to be lying directly in the cytoplasm after the end of prophase.

Fig. 4. The model of cell torsion fields at the end of telophase (A and B) and prophase (B). Sl - "left" orientation of the torsion field; Sr - "right" orientation of the torsion field. In the "left" intercellular torsion field molecules of ferments (proteins) generate dissipative molecular structures ("nonequilibrium molecular constellations") with the peculiar ability to self-organization. Being in excited state, nonequilibrium molecular structures interact with a cellular torsion field.

A - uncoiling of chromosomes completes at the end of telophase; the equilibrium is established between the "right" torsion field of chromosomes and "left" torsion field of the inner side of the plasma membrane on a definite distance inside the cell. Cell membranes with corresponding ion channels orientation are formed in this place.

B - the final stage of telophase after the isolation of sister cells.

C - spiralization of chromosomes is completed by the end of prophase; chromosomes are seen in a light microscope; the "left" torsion field of coiling chromosomes collides with the nucleus membrane torsion field generated by ion channels resulting in the destruction of the cell membrane; chromosomes appear to be lying in the cytoplasm.

3. There is an undoubted interest in the question of the character of the cell field during relative rest of chromosomes after they have completely despiralized at the end of telophase and have not entered yet in the synthetic phase, i.e. in the G1 period of interphase. This period can be relatively short for actively dividing cells, while it is quiet long for the cells of the tissues where divisions occur seldom or even ceased.

As it has been stated above, in this period the chromatin is in relative rest, and chromosomes transformations do not have such strict direction as it is in two previous cases (The periodical transcription of the same genes complexes apparently definitely contributes to the common field of the cell, however, as it has already been mentioned, this most likely does not significantly influence the cell field). Generally speaking, the processes taking place in the chromatin in this stage must be symmetric: the spiralization should be balanced by the despiralization, a movement in one direction - by a movement in the opposite one. However, at the same time the character of the cell field - external field shell - "right" - should be preserved. How can it be imagined?

Firstly, by the use of the notion about the pulsation in the form of travelling waves, which is rather common for natural periodical processes. The change of day and night is a wave travelling over the Earth's surface, the seasonal temperature change is a wave pulsating from the pole to the pole, the blood moves through the organism by the undulatory impulses as a result of heart beats.

Secondly, by the use of data about the internal structure of a cellular nucleus extrapolating it for the G1 period of interphase. As it has been mentioned above (See Fig. 3), pre-replication centers are formed in a developing nucleus at the end of mitosis [7]. These centers transform to valid replication centers after the renovation of the nucleus membrane. Thus, the following conclusions can be made from this: 1) replication centers are most likely situated at the periphery of the nucleus since they are connected with its membrane; 2) these centers influence the realization of rotating motions of the DNA helix, since they participate in its winding-unwinding during the replication.

There is one more experimentally proved fact. In the work [8] it is shown (Fig. 5) that sister chromatids being tightly linked in metaphase are reflection symmetric to each other. It indicates that one of them has a right spiral, while another - a left one. In other words, on the level of superspiral the chromatin can possess both right and left arrangement.

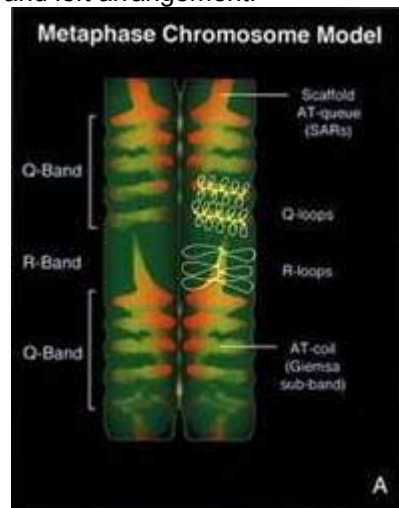


Fig. 5. Metaphase model of the chromosome [8].

In the work [8] it is shown that in metaphase the sister chromatids being tightly linked are reflection symmetric to each other. It indicates that on the level of the external superspiral one of them is in the form of a right spiral, while another - a left one.

Let us assume that the pulsation in a nucleus occurs from the periphery to the center and backwards. As it was mentioned above, on the nucleus periphery, near the membrane there are replication centers capable to realize a rotatory dynamics of the chromatin. It is not experimentally proved yet what there is in the center of the cell nucleus, however, it is logically to suppose that centromere regions of chromosomes are grouped there. Since it is well known that during anaphase of mitosis chromosomes move towards the poles in the form of pins exactly with their centromere regions along the spindle threads (if it exists), which meet in the polar regions. Therefore, the grouping of chromosomes centromeres in the central region of the nucleus does not look so improbable.

On the basis of all above mentioned we can see the following dynamics of the chromatin inside the nucleus in the G1 period of interphase (Fig. 6).

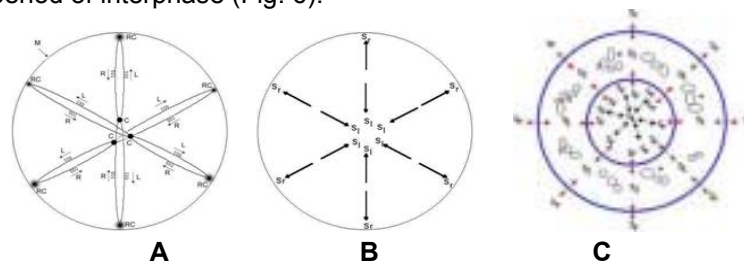


Fig. 6. Dynamics of the chromatin inside the nucleus in the G1 period of interphase.

A - diagram of chromosomes arrangement inside the cellular nucleus in the G1 period of interphase: M - the cell's membrane; RC - replication centers linked with the membrane; C - centromere regions of the chromosomes; R - "right" superspiral moving from the nucleus periphery (replication centers) towards the nucleus center (chromosomes centromeres); L - "left" superspiral moving from the nucleus center (chromosomes centromeres) towards the nucleus periphery (replication centers). B - diagram of the polarization of the nucleus internal space by the waves of chromatin superspirals moving along the chromosomes.

C - torsion model of a cell in the G1 period of interphase.

The G1 period of interphase sees the establishment of the pulsation mode - exchange with short, as compared with the nucleus radius, waves of a superspiralized chromatin between replication centers and centromere sections of chromosomes. Moreover, "right" superspiralized waves move from the periphery to the nucleus center, while "left" ones - from the nucleus center to the periphery (Fig. 6, A). A moving part of the spiral - "the wave of spiralization" - is spiralized on its leading edge and despiralized (uncoiled) on its falling edge. At the same time it should be taken into account that a right spiral wave polarizes the space in the following way: the "left" torsion field is ahead and the "right" one is behind, while a left spiral wave does on the contrary: the "right" torsion field is ahead and the "left" one is behind. Then as a result we see a stable picture of cell nucleus space polarization in the G1 period of interphase - the "left" torsion field is in the middle, the "right" one is directed towards the periphery, to the membrane of the nucleus, as it is shown in Fig. 6, B. Thus, the torsion field of a nucleus in the G1 period of interphase is coordinated with the fields of the nucleus membrane ion channels and assures the existence of a stable torsion-biological field of the cell, as it is shown in Fig. 6, B.

The doubling of chromosomes occurs in the S period of interphase by means of nucleus replication centers. This process seems to consist of a great number of local acts of despiralization and further spiralization of now doubled DNA segments (according to the facts presented by the authors of the work [7], 100-300 replication centers are generated in the cell nucleus). It is naturally to assume the presence of pulsations during the replication similar to those in the G1 period of interphase - the impulses of running superspiral segments are associated with the function of uncoiling-coiling of the DNA helices. However, in this case the spiralization passes with significantly higher frequency. Thus, the cell field intensity increases during the cell preparation to division, but in general the character of the interphase field remains the same (Fig. 6).

In the G2 period of interphase chromosomes are already doubled, however they remain to be tightly linked and despiralized. It can be generally supposed that this period does not differ significantly from the G1 period, concerning the chromatin dynamics, see Fig. 6.

In conclusion to this chapter, the following should be noted. It seems logical to suppose that while the constituents of the torsion field preserve their general orientation character (external torsion field is "right"), it has strictly individual structure for every kind of cells. The cell field is dynamic and it changes in time depending on a location of the cell and its functions as a part of a multicellular organism. These changes must be seen the most evidently in the process of cell division, in the process of embryogeny, etc.

Thus:

- genomic DNA functioning in a cell together with chromosomes fulfils ordered repeated rotatory movements in the process of its own cycle realization in each stage of a cellular cycle;
- it is assumed that at the same time the chromatin becomes a source of torsion fields;
- torsion fields generated by the chromatin are specific and highly dynamic; they influence intercellular protein molecules which are in excited state and ensure the vital activity of the cell interacting with external torsion fields; it can be said that on its basic level the biological field consists of molecular torsion fields generated by the chromatin (chromosomes).
- mitogenetic radiation is an integral part of interactions in the context of the cell field.

Some aspects of the biological field of mitosis.

A.G. Gurvich studied mitosis in details. These were the works dealing with the study of mitosis which became the origin of the research that resulted in discovery of the biological field and mitogenetic radiation. Some observations over the dynamics of cell division are actual till now. For example, the proof that the mitotic spindle is a nonequilibrium dynamic formation [9] and not a stable permolecular structure as it is considered to be today.

In this chapter we will consider the results of one of two published works [10], where the interaction between chromosomes - mitotic figures - during mitosis is examined, and will try to explain the observed phenomena from the positions of views developed here.

The work "Morphological changes of mitotic figures as a results of their interaction"

("Морфологические изменения митотических фигур в результате их взаимодействия") was written by Ye.Ch. Pukhal'skaya - a colleague of A.G. Gurvich.

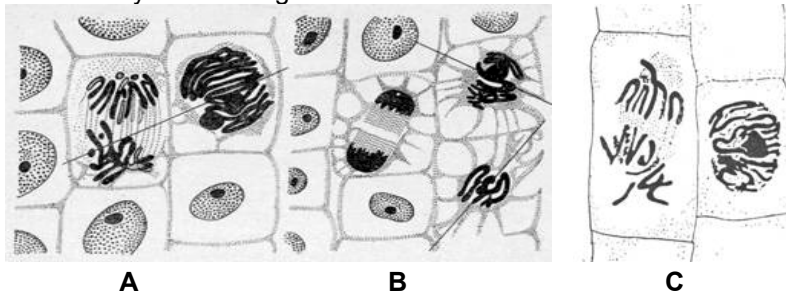


Fig. 7. Illustrations from the work [10].

The illustrations A and B of the work are signed: "The result of spireme's influence upon anaphase".

B - "Symmetric telophase. The axes of neighbor spiremes do not intersect with it".

The images were received with the help of onion rootlets mer-istem. In Fig. A and B the axes of mitotic figures were depicted for the convenience of perception.

It is clearly seen that if the axis of a chromosome figure in prometaphase (spireme) crosses the axis of another mitotic figure which is in anaphase, the chromosomes of anaphase figure are strongly repelled by prometaphase chromosomes.

Now it is important to remind two things. 1. In the biological field conception by A.G. Gurvich the action of a field (including a chromosome one) was assumed as repelling. 2. At that time nothing was known about the chromatin (chromosomes) structure and no sup-positions were made about physical nature of the biological field.

The work examined interaction between mitotic figures of di-viding cells in cerebral vesicles of the triton and axolotl as well as during mitosis in onion rootlets and larch spores. It was found that during mitosis in neighbor cells and on conditions that the axis of a mitotic figure of one cell crosses the axis of chromosome figure in an-other cell, this causes the deformation of the latter (Fig. 7). Moreover, it was proved that these were the interactions between the chromosomes that caused the observed influence, and they were not at all connected with the change of turgor pressure in neighbor cells, etc. Fig. 7, A and B show the influence of mitotic figures being in the stage of spireme (the stage of prometaphase) on chromosome figures which are in the stage of anaphase. The interaction is obviously repelling. As A.G. Gurvich wrote: "the chromosomes arrangement in diaster (anaphase - comment by the author) is violated as if influenced by a strong wind" [9, p. 258]. The repelling action of the chromosome field on the neighbor telophase is observed as well during the influence of the mitotic figure which is in the stage of prometaphase (Fig. 8).

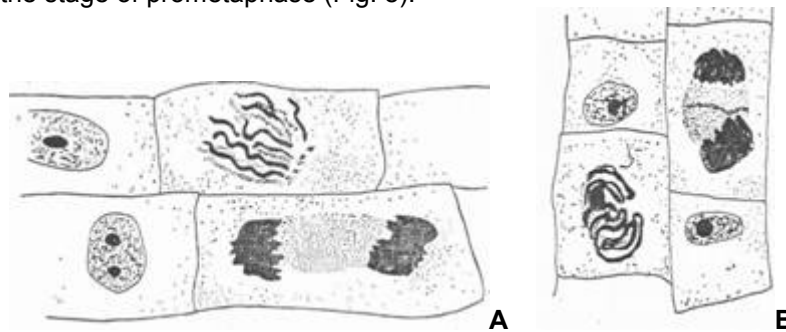


Fig. 8.

The results of spireme influence on the neighbor telophases [10]

If examined attentively, it is seen that chromosomes in telophase repel on the condition that the axis of the mitotic figure of the chromosome of a neighbor cell in the stage of prometaphase is directed at them (the same results are obtained with meristems of onion rootlets).

However, one can observe a different interaction, which during a close examination of images can be characterized as the establishment of a definite reciprocal orientation of mitotic figures' axes, definite "coaxiality" (Fig. 9)

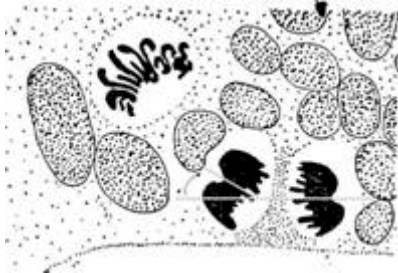
However, in this case it concerns the influence of metaphase of anaphase mitotic figures on a chromosome figure of telophase or the interaction between two anaphase figures (fig. 9, D). At the same time one can observe the turn of a chromosome plate that appeared to be on the intersection with the axis of the mitotic figure of a neighbor cell.

Now let us consider how we can present events occurring on separate stages of mitosis in respect to chromosomes rotatory dynamics.

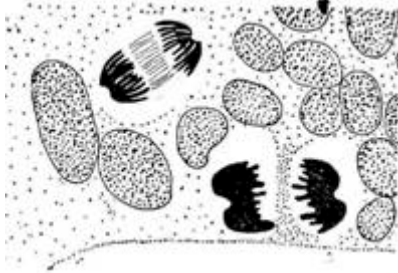
As we could see in the previous chapter, the spiralization of chromatin, which starts in the stage of prophase, causes the destruction of cell nucleus shell.

The spiralization actively continues in the stage of prometa-phase (spireme), and in Fig. 7 and 8 we can observe the result of the action of the field which is composed of fields of chromosomes oriented more or less in parallels.

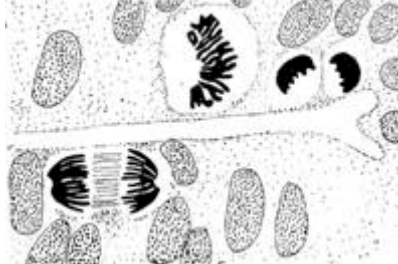
Fig. 9. The interaction of chromosomes plates in the late stages of mitosis - metaphase, anaphase, and telophase.



A - image from the work [10]: "A cerebral vesicle of an axolotl. The shift of one of daughter plates of telophase under the influence of properly situated metaphase"; we depicted the axes to show that this is the turn of one of daughter chromosome situated meta-phase"; we depicted the axes to show that this is the turn of one of daughter chromosome plates that causes the fracture of the axis - compare with the Fig. A, where the same image is reconstructed.

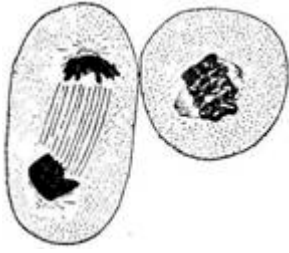


B - the reconstruction of the image from the Fig. A; it is shown that if the axis of the neighbor mitosis did not cross the axis of the telophase figure, the latter would remain symmetric.



C - the image from the work [10]: "A cerebral vesicle of an axolotl. The asymmetric telophase influenced by metaphase is above. The symmetric anaphase which the axis of metaphase does not cross with is below".

It is seen how abruptly one of the telophase plates turned. One can assume that the extrusion of the telophase plate axis from the area of metaphase chromosome field influence is caused by the fact that from this side of the metaphase plate chromosomes with left external super-spiral are uncoiled.



G - the image from the work [10]: "Two neighbor maternal cells of larch pollen. The shift of one of daughter plates of telophase at which the axis of early anaphase is directed". The turn of the telophase plate and coordination of the direction of its axis with the axis of anaphase figure is obvious.



D - the image from the work [10]: "The reciprocal deforming action of two mitoses in one maternal cell of larch pollen"; one can see that anaphase plates of neighbor mitoses turn so that to combine their axes.

Why does this field repel the chromosome plates which appear on the intersection with this field in the stage of anaphase or telophase? That occurs because in anaphase and telophase chromosomes are already being dispiralized and correspondingly possess the opposite rotatory dynamics. Thus, the key moment of mitosis is metaphase - a very short period of change from prometaphase to anaphase, to the migration of chromosomes to the poles of a dividing cell. On the basis on the above mentioned we can assume that it is in metaphase, in its final point when chromosomes uncoiling commences. Here it is important to recall (Fig. 5) that sister chromatids of a doubled chromosome are reflection symmetric, i.e. they have different spiralization of their final spirals: one - right, another - left. Naturally, during the simultaneous unraveling each of sister chromatids possesses the opposite, with respect to another one, rotatory dynamics that causes their repulsion - the movement of chromosomes from the cell equator to the poles starts. This allows to explain the deviation of chromosomes among the species which do not have the achromatic spindle during their division.

On the contrary - the rotatory dynamics of chromosomes in a de-veloped anaphase and telophase is the same - chromosomes are being dispiralized. Therefore, the interaction between mitotic figures of neigh-bor cells in anaphase and telophase leads not to repulsion but to the es-tablishment of acceptable reciprocal orientation of chromosome figures' axes (Fig. 9G and D).

Fig. 9 A and C should be especially considered. In both cases te-lophase chromosome plate is influenced by the metaphase chromosome figure. This is apparently the end of metaphase in both cases - the uncoiling of external chromosomes surepspirals has begun. In telophase the chromosomes have certainly went through the stage of external superspiral uncoiling and are now the uncoiling "right" spirals. (It would be logical to assume that the difference in the direction of spiralization is only on the level of external, "final" superspirals. As in the opposite situation the chromosomes despiralizing in telophase cannot renew a cell nucleus in accordance with the diagram in Fig 4 A). We do not know how sister chromatids of different species migrate to the pole - all with the "right" superspiral in one direction, with the "left" - in opposite, or in definite proportion. However, if in the case with axolotl all "right" chromatids migrate in one direction, while the "left" ones - in the opposite, this allows to explain the ambiguity of metaphase figure influence on telophase plates in a neighbor cell. Indeed, in Fig. 9 A the telophase plates turns so that to coordinate its axis with the axis of the metaphase figure, while in Fig. 9 B the axis of the telophase plate is expelled beyond the bounds of the cone of the influence of the neighbor cell's metaphase figure.

The colleagues of A.G. Gurvich published only two works about the influence of chromosome fields. These highly interesting re-search works require subsequent study. Understanding the disputability of our considerations, we hope that the hypothetical ideas stated here will contribute to following works in this direction.

In this work we did not consider complex, coordinated evolu-tion of chromosomes, the evolution of the chromatic figure during prometaphase - the beginning of metaphase. There are undoubtedly all reasons to believe that these movements are as well concerned with the chromosomes rotatory dynamics. However, the formulation of an inte-gral and non-contradictory idea about biological filed evolution during mitosis requires detailed and laborious research concerned with the formation of adequate ideas about the DNA spiral and chromatid con-struction. We would like to finish this chapter

with the following words by A.G. Gurvich: "...the assembly of chromosomes forms a system aiming at an instant equilibrium. Such equilibrium however is never achieved because the proper fields of chromosomes constantly change. Thus, one cannot speak about the condition of real equilibrium but only about the course of system development whose elements influence each other, and the character mode changes depending on a condition in a given moment" [9, p. 258].

6.

Discussion of the proposed model.

A fundamental fact in the considered model is that on the one hand the basis of the biological field is a fundamental physical field - torsion one - and on the other hand, the realization of this field in the animate world has specifically biological character, i.e. the biological field is defined by the torsion fields generated by the chromatin.

The important feature of the considered model is an integral idea about a cell. The cellular (torsion) field is in its essence an embodiment of a unique ordering principle (invariant) in the organization of a bioplast.

Some aspects of the hypothesis and consequences.

The hypothesis substantiating the decisive role of torsion fields in the occurrence of a biological cell field presumes the presence of rotatory movement in the dynamics of the chromatin. Although this supposition requires to be experimentally proved, it looks quite possible. The supposition about the presence of periodical pulsation in an interphase nucleus raises more doubts. In this suppositions we took into account the known experimental results and in our reflections we based on the natural principles of vital processes organization:

a) the presence of obligatory structural-dynamical order - chromatin pulsation in the nucleus is supposed to occur between replication centers situated at the periphery and centromere segments concentrated in the center;

b) indispensable cyclicity of natural processes.

Author knows that the cell nucleus is considered to be tightly packed with chromatin threads, something like shown in Fig. 10. However, we do not consider it to be an obstacle for pulsation in the form of travelling superspiral waves, moreover, the precise order inside a native nucleus is unknown. The Fig. 6 A naturally should not be taken literally. It is meant that reciprocal arrangement of the centromere - replication centers - specifies the principle of intranuclear order. And numerous folds of chromosomes are oriented radially - between the center of the nucleus and its membrane. The ideas about the presence of ion channels in the nucleus membrane can as well seem to be not completely indisputable for today, but from our point of view, the presence of active transmembrane transportation of ions, first of all protons, through the nucleus membrane is clearly indicated by the difference between the pH of karyoplasm and cytoplasm of a cell.



Fig. 10. A partially uncoiled chromosome (U.K. Laemmli).

Only histons were removed from the chromosome. Scaffolds are clearly seen among chromatin threads. An uncoiled chromosome is shown on the insertion. Scale (below) - 2 μ m.

The number of conclusions can be made from the proposed model of a biological cell:

- the cells which have similar in their structure individual external field can easily form a definite living organism tissue; the ones which possess different individual field during the contact with the former can form a border between different tissues (organs);
- the entire system of concentric fields of a cell can change its direction during the change of the pulsation character in the interphase nucleus and change of direction of superspirals' waves movement to the opposite ones, "left" ones - to the center of the cell, "right" ones - from the center (Fig. 6 A); an external cell field will become "left"; this will lead to the incompatibility of a reborn cell with neighbor cells (tissues); it is not excluded that similar processes occur during the carci-

nogenesis, and thus cancer cells have "left" orientation of their external torsion cell field;
- tissues of an adult organism, which completed its growth, possess as a rule a weaker biological field
- cells of a specialized tissue either do not divide at all or the division occurs rarely; however, this field is more specialized - the specificity of its cells, tissues and correspondingly fields of various organs is conditioned by the fact that a definite set of genes is constantly activated in them, which influences the character of general dynamics of the chromatin.

- the mitogenetic radiation plays an important role in intercellular interactions and formation of a unified informational environment of the organism [3]; some ultraviolet quanta are enough for a cell to pass on to the division; apparently, the mitogenetic radiation, which possess a torsion component, specifically destabilizes the biological field of the cell putting it into such nonequilibrium condition that cell division is a natural result of this condition.

Comparison of the proposed model with the observed phenomena.

It is known that the most powerful morphogenetic field is generated around a developing embryo, actively growing tissues (for example, among plants - developing buds, the cone of the growth of rootlets, etc.) [1]. Indeed, cell divisions pass with high frequency in intensely growing tissues. Before the cell division in the S period of interphase the doubling of chromosomes occurs in the process of replication, and according to our model, the cell field intensity increases (See Chapter 4). It is known that "...spin polarization conditions are metastable" "...resulting in the occurrence of torsion phantoms" [4, p. 14-15]. It says that an intensifies biological field of an embryo, actively growing tissue creates in the ambient space a dynamic informational "scaffold" which determines its development. The biological field controls the morphogenesis in this way.

The biological field of an adult organism ensures its integrity, processes coordination, supports the regeneration of tissues and organs through information. This is due to the biological field how an organism "knows" which and how much a renovated tissue should be, which regenerated organ it should be.

The cell, which organizational foundation is a multi-layer system of concentric and self-coordinated torsion fields, must have considerable steadiness to various external field influences that can be observed in reality.

The presented simplest torsion model of a cell allows to explain the known negative influence of "left" torsion fields on living systems. In particular, the decrease in cell membranes penetrability [5, p. 56], decrease of oxygen consumption by isolated mitochondria, etc. under the influence of the "left" torsion fields of the environment. First of all, this can happen due to disorientating influence of external "left" torsion fields on "right" torsion fields of membrane ion channels. In the end this results in the violation of vital activity processes of a cell.

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