

Review Article*Open Access, Volume 5***Microwave environment and medicine (1994-2024): From the inhibition of malignant mitosis, to pandemics of covid19, HIV, rheumatoid arthritis, and epilepsy****LA Baranova^{1*}; SV Avakyan²**¹Ioffe Institute of the Russian Academy of Sciences, Politekhnikeskaya St 26, St Petersburg, 194021, Russia.²All-Russian Scientific Center "SI Vavilov State Optical Institute", Birjevayay line, 10, St Petersburg, 199034, Russia.***Corresponding Author: LA Baranova**Ioffe Institute of the Russian Academy of Sciences,
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Abstract

We present a Review with the final results of our original approach in thirty years of research in medical biophysics, for the first time taking into account microwave emission in the physics of solar-biospheric connections, including in the earth's ionosphere using very highly excited Rydberg levels. It was our introduction into solar-terrestrial physics of the very concepts of the Rydberg state in the environment and in its biosphere that allowed us to determine both all sources of microwaves and the role of the unique increase in pressure on modern ecology of anthropogenic noise over these 30 years and to obtain integral final results in medical biophysics.

A modern, radical solution to the main problem of the physics of solar-terrestrial relations became possible thanks to our introduction since it opened a previously unknown channel for the constant influence of space weather factors on terrestrial processes and the state of the human body. This happened in the early 1990s, when we proposed a new agent of the impact of geocosmos on a set of processes in the lower atmosphere and biosphere - the microwave radiation of the earth's ionosphere, emitted by all its atoms, molecules and their ions when high-energy (Rydberg) states are excited by photo- and secondary electrons mainly during solar flares and geomagnetic storms. This made in our approach - supramolecular physics of overmolecular structures of molecules with high affinity for the proton (including water in a living organism).

We took into account the pioneering experimental and theoretic works, published in 1980 -1985 years, in which the possibility of the formation of "polyatomic Rydberg molecules" in such cases was found. Here we used the analogy with molecular protonics considered for the biomedium within the framework of supramolecular chemistry.

The main results of recent years relate to the proposals of physical mechanisms for solving pressing biomedical problems:

The impact of electromagnetic radiation of the environment on association formation in aqueous solutions and for the first time we proposed to take into account induced emission in the optics of the environment according to the postulate of A. Einstein; the influence of microwave radiation from geocosmos on the state of a living organism, while presenting possible explanations for the periodically observed

temporal non-repeatability of a number of known biophysical experiment.

The contribution of microwaves to the possibility of suppressing malignant mitosis; detailed consideration of the mechanisms of influence of microwave fluxes on the behavior of viruses in the biosphere a demanded, fully justified advance forecast of a significant drop in the level of the current Covid19 pandemic based on the results of observations from the Solar Dynamic Observatory spacecraft (USA) and made on the basis of a comparison with the Spanish flu pandemic - "influenza" in 1918: by the nature of the redistribution sunspot structure in the northern and southern solar hemispheres.

Confirmed link of rheumatoid arthritis with prevalence of low fraction in synovial fluid during solar flares and geomagnetic storms, as well as possibility and exogenous approach to epilepsy.

In this review, it should be emphasized that all our studies have been particularly relevant in recent years due to the sharp increase in anthropogenic microwave noise, taking into account the possible contribution of the known mechanism of statistical resonance.

Keywords: Microwave radiation of the terrestrial ionosphere; Anthropogenic microwaves fluxes; Rydberg states; Associates - supramolecules; Induced microwave emission.

Introduction

The history of the Earth signals to us that Humanity, like almost all living things, is under threat of potential cataclysms. This includes the asteroid-comet hazard, the consequences of Supernova explosions (magnetars), excesses of solar-terrestrial physics, tectonic phenomena, weather-climatic anomalies, and in our time, all this is superimposed by a permanently increasing burden of the probability of trigger phenomena from anthropogenic impacts on the environment. In doing so, we consistently follow both the approaches of our compatriot predecessor A.L. Tchizhevsky and the advice on the paths of scientific development of A. Poincaré. Jules Henri Poincaré in *La Science et l'Hypothèse* said: "Science is built up with facts, as a house is with stones. But a collection of facts is no more a science than a heap of stones is a house."

In [1] a telling statement by Professor M. McMenamin: "we see a profound difference between Western (extrapolation, predictions) and Russian science (assertive scientific generalization", commentary 48, p. 54). Let us stick to this domestic approach as much as possible in this review.

In [2] we presented our concept for the first time, and considering the significance of this text as documentation for all our subsequent works, we cite this text in full: "The paper proposes to consider electromagnetic radiation of highly excited Rydberg states of atomic-molecular neutral and ionized particles of the main atmospheric gases in the physics of solar-terrestrial relations. These are electronically excited states with a large principal quantum number ($n > 10$) and their radiation occurs in a very wide range of the spectrum, including all transparency windows

of the Earth's atmosphere from the IR regions to meter radio waves. The rate of excitation of Rydberg states in the upper atmosphere by electron impact by photoelectrons and secondary electrons is several times higher than the rates of optical and UV excitation of all the main atmospheric gases. The highest relative rates of formation of Rydberg states (an order of magnitude higher than the ionization rates) are observed at night and here they are directly proportional to variations in the flux scattered in the geocorona of solar radiation in the VUV lines. The probability of excitation increases twofold with altitude from 360 to 180 km, and from conditions of a quiet Sun to a solar UV flare, especially after an isolated geomagnetic storm, the rates of formation and emission of Rydberg states increase several times. It was precisely during the discussed type of space weather that an increased planetary excitation of the F-region of the night ionosphere was observed during periods of solar flares from the orbital station "Salyut-6". On the topic of this conference, it is important to emphasize that it was precisely during the same periods of increasing intensity of optical glow and ionization of the upper ionosphere that the cosmonauts recorded in their diaries increased nervous excitability and conflict in relationships. Analysis of the presence of geomagnetic pulsations in the same observation intervals at the Borok station showed their absence for the Pi1C type, as well as for Pc2, Pc4 and in most cases for Pc3. The previous day always saw a change in the sign of the Interplanetary Magnetic Field sector, and thus all aspects of space weather that are already known to contribute to disturbances in the human central nervous system are present. Since the main source of excitation of the Rydberg states of gases in the upper atmosphere are photoelectrons and secondary electrons, as well as recombination processes involving ions in

the ionosphere, their density significantly increases during solar flares and corpuscular precipitation following an increase in ionizing radiation flows. The characteristic radiation of Rydberg states covers virtually the entire range of the electromagnetic spectrum of upper atmospheric emissions, and their collisional quenching significantly heats the gas in the upper atmosphere. These processes can manifest themselves in the already studied radio emission of near-Earth space, associated with the impact of solar short-wave radiation and energetic particle intrusions on the ionosphere." This text is presented without citing the 6 references to the Literature available in the Original Abstract; see the Conclusion Section for more details.

This pioneering work of ours [2] was also noticed in was subsequently [3] 2002 the transitions of electrons between high Rydberg levels of molecules of neutral components of ionospheric plasma were experimentally registered for the first time, and it was proven that it is the physical mechanism of excitation of Rydberg levels proposed by us in 1997 (according to the article by [4]) - excitation of such levels during their collisions with accelerated electrons is the most probable (of the three, the possibility of which was analyzed by the authors [3]). Thus, the results of our works [4,5] on the effectiveness of the Rydberg mechanism in the ionosphere are confirmed, which is recognized in the fundamental review [6].

Our first work [2] actually coincided in time with the publication of A.L.Tchizhevsky's pioneering prediction on the connection of life with "cosmic forces": "In reality, life is determined by the aquatic environment and the colloidal (colloids have dimensions: 1 nm-1 μ m) system. The sensitivity of a chemical system to the influence of cosmic forces is associated with its structure - in other words, with the geometric and energy factors of its molecular structure and the complexity of its organization. As the structure of water and its colloids is studied, this opinion is becoming stronger every day" [7]. What is surprising here is that the author, having expanded the usual concepts (clusters-associates) to colloids, turned out in reality to be closer to the sizes of molecular structures in Rydberg states.

Of course, it is well known that in all previous, earlier books by A.L. Tchizhevsky [8-11], a similar approach was also developed, perhaps not so clearly formulated.

Objectives and tasks of the review

The objective of the review was to identify all channels of radiation of microwave fluxes of emission radiation of the Earth's ionosphere, permitted by quantum mechanics, taking into account the contribution of the continuous increase in anthropogenic noise, primarily from the development of mobile communications.

The tasks of the work included:

Determining the multifactorial influence of microwave fluxes on the biosphere and human health;

Assessing the prevailing role of the impact of microwaves in the problem of solar-biosphere connections based on the analysis of the intensity of fluxes of other cosmic factors;

Detecting the main sources of negative radiation in the sub-ranges: mm-, cm-, and dm-;

Studying the role of proton transfer as the main mechanism of formation of "polyatomic Rydberg molecules", which are the source of formation of clusters-associates in supramolecular

physics;

Presenting the main results of supramolecular chemistry used in supramolecular physics;

Presentation of achievements that are important for modern medical biophysics in such areas of human health pathologies as viral pandemics, arthritis, oncology, etc.

Confirmation of the important role of the postulate on the generation of induced microwave radiation in a thermodynamically equilibrium environment, including the human body, proposed in 1916 by A. Einstein, first taken into account in our articles, including, JCIMCR: "Microwave radiations of environment: possibility of inhibition of malignant mitosis", August, 2022 [12].

Microwave radiation of the environment: Analysis of sources and flux parameters

The microwave range includes radiation with wavelengths from 1 mm (frequency 300 GHz- Extremely High Frequency (EHF)) to 1 m (frequency 0.3 GHz - Ultra High Frequency (UHF)), with an intermediate microwave range: Frequencies from 3 to 30 GHz with a wavelength (10 - 1 cm) - Super High Frequency (SHF).

Our research in the field of excesses of solar-terrestrial physics, namely, the study of the entire scheme of the impact of the most significant phenomena: solar flares and especially global geomagnetic storms in their modern form, were most fully presented for the first time in the Invited paper "Radio-optical mechanism for the solar and magnetospheric influence on the weather and climate" [13], p.16, Kyoto, Japan, 2007, within the framework of the first day of the International CAWSES Symposium at the Research Institute for Sustainable Humanosphere, Kyoto University. CAWSES (Climate and Weather of the Sun-Earth System) is an international program that includes major topics - solar influence on climate, space weather: science and applications, and so on. Our report summarized a new approach, which is also being implemented in this publication, on the original physical mechanism of generation of microwave radiation of the Earth's ionosphere during solar flares in the X-ray and extreme ultraviolet ranges, and most importantly, during global geomagnetic storms, when the electron flows are large, spilling out of the Earth's radiation belts into the upper atmosphere and mid-latitudes. It is important that already then we took into account the possibility of excitation of high-lying (close to the ionization potential of the atomic-molecular particle) electron Rydberg states, including water molecules, as well as the strong dependence of such a process on the value of the orbital quantum number, characterizing the depth of penetration of the Rydberg electron into the rest (ionic) core. After all, this is what determines, within the framework of supramolecular physics, what will be the final yield of stable supramolecules (clusters - associates) from the same water molecules. The objective of the report and the entire symposium was to assess the results of research in the field of solar-geomagnetic weather-climate relationships, which determined both the name and the attention to the issues of heat balance in the troposphere [14]. In the future, having generalized the supramolecular approach to biophysical effects [15], as in this review, we use a single, more adequate approach from the standpoint of the basic education of the authors (fundamental physical optics) and the experience of their many years of work in the field of physics of atomic collision processes, in the synthesis of which the supramolecular physics of the environment surrounding humans and the entire

biosphere was created. At the personal suggestion of Fellow of The Royal Swedish Academy of Sciences, who was present at the CAWSES Symposium in Kyoto, representative of The Royal Institute of Technology (KTH) at Alfvén Lab., Stockholm, Prof. Carl-Gunne Falthammar, we have regularly presented our results to him since 2011, including issues of microwave medicine. The importance of collision processes is obvious both for the mechanism of generation of the microwave emission radiation flux in the ionosphere and in the lower atmosphere, and especially in the body of a biological object, including a human. After all, the dimensions of the orbit of a highly excited electron in Rydberg states are very large - its radius can even reach fractions of a mm. In [16] it was found that in the earth's ionosphere, collisions that quench microwave emission are insignificant above 115 km. The question of the lifetime of Rydberg states in the liquid medium of an organism is associated with the influence of collisional quenching processes. The interaction of a Rydberg atom/molecule as a whole particle with a colliding component of the medium (usually this is a neutral, as in our case, biological medium, atomic-molecular component) was considered in [17]. A real collision between an electron and a neutral atom/molecule occurs at shorter distances than a Coulomb collision. Consequently, a highly excited electron interacts with a neutral only when they are very close and this collision is much shorter in time than in the interaction of charged particles. Since the ion core (electrons in the inner shells and the nucleus) is far from the Rydberg electron, its presence is unimportant in electron-neutral collisions. It can be assumed that the extinguishing effect of such a collision is small.

It is necessary to dwell on the interpretation of the pioneering experiment on registration of microwave radiation from the polar aurora with an attempt to involve the Rydberg transition scheme [18]. The signal from the polar aurora region was recorded by a ground-based radar at a frequency of 3 GHz. It was found that if the physical mechanism for the excitation of this ionospheric microwave radiation is based on plasma oscillations, then thermal ionospheric electron density $N_e \sim 10^{11} \text{ cm}^{-3}$ should be. The possibility of cascade processes after capture from $n = 121$ to $n = 120$ was also taken into account, and it was found that this makes an insignificant contribution. But in doing so, it was necessary to take into account all the possibilities of generating microwave emissions of the main upper-atmospheric components: atomic oxygen, molecular nitrogen and oxygen, and not just the atomic composition. The need to take into account the molecular composition of the upper atmosphere at altitudes below 180 km and, accordingly, the mixing of electron (Rydberg) states with the network of vibrational-rotational levels was not taken into account, although as shown in the classical work of N.S. Kardashev [19] and confirmed in [20], fig. 2.40, where the energy levels in the cm-range correspond exactly to $n \sim 100$. The authors [18] performed their analysis within the framework of the processes in the atomic plasma of the earth's ionosphere. Obviously, this was apparently an incorrect approximation, since the aurora are most intense in the altitude zone below ~ 180 km - the boundary of the transition of oxygen atom densities into the underlying plasma based on molecular nitrogen (where there is no longer a real quantum ban on radiative transitions, due to the emergence of vibrational-rotational levels of molecules. Here, we should bear in mind that the molecules (including those in the cluster associates) have vibrational and rotational degrees of freedom and this leads to the emergence of a multitude of energy levels. The electronically excited (Rydberg) levels are more closely located than the

vibrational and even rotational levels of the ionic core already at the main quantum number of $n \geq 8$ [21]. Thus, the condition for the Rydberg levels of the water-containing associate and the biomolecular component is practically achievable in the microwave energy range.

It should be noted that already in our report [5], and earlier in the program article for the case of the polar aurora [22] all the possibilities of generating microwave emissions of the main upper-atmospheric components: atomic oxygen, molecular nitrogen and oxygen were taken into account, not just the atomic composition.

The main conclusions are as follows

Microwave radioemissions of oxygen atom, taking into account the rules for selecting forbidden quantum electric dipole transitions (including Rydberg ones) are realized: in dm radioemission: $\Delta n = 0$ at $n = 20-40$, cm radioemission: $\Delta n = 1$ at $n = 10-20$, or at $l = -1$ and $n = 10-20$, and mm radioemission: $\Delta n > 1$ at $n > 10$. For N_2 and O_2 all emissions of microwaves are realized at $n \geq 3$;

According to [22], figure 3: the high function of excitation rates for Rydberg states for auroral zone (night aurora, IBC II) occur as in: the total excitation for nitrogen (1) and for oxygen (2) molecules, and for the partial excitation transitions with different Δl and Δs for atomic oxygen (3-5): (3 - $\Delta s = 0$; 4 - $\Delta l = 1$, $\Delta s = 0$; 5 - $\Delta l = 0$, $\Delta s = 0$).

It should be noted that even in [23] an analysis of the causes of the experimentally detected (p. 148) biological effect of microwaves on heating was carried out, and the trigger effect with subsequent excitation of collective chemical processes (p. 121) was used. However, this approach has not been developed, which is understandable in light of the development, exactly since 1980, of supramolecular physics of Rydberg excited polyatomic molecules with high affinity for protons: [24]. In this work, which is programmatic for our review, the entire mechanism of formation of "Polyatomic Rydberg molecules" [25] is presented briefly, which forms the basis of supramolecular physics: "The reason why the Rydberg states of H_3 are stable is clearly the high stability of H_3^+ (or in other words the high proton affinity of H_2) which ensures that all Rydberg states of H_3 lie well below the energies of all excited states of the dissociation products $H+H_2$ (p.1248). It seems reasonable to expect that other molecules, say X, with a high proton affinity will also give rise to stable Rydberg states of corresponding neutral species XH. Examples would be H_2O , NH_3 and CH_4 , all of which give very stable ions when a proton is added. It thus seems possible that Rydberg spectra of H_3O , NH_4 and CH_5 will eventually be observed" [24].

No less important for our review is the work [26], where the situation with the mechanism of signal amplification at the carrier frequency in the presence of a background flow in a wide frequency range is considered. In our case, this could be an anthropogenic signal from mobile communications, superimposed on the spectrum of microwave emission radiation of the ionosphere. Here are the conclusions from [26]: 1) Stochastic resonance is a phenomenon in which, under certain conditions (in multistable or bistable systems), an increase in the operating noise leads to a more ordered behavior of the system. 2) This is a cooperative effect in which the noise energy, distributed over a wide spectrum, is pumped into the output energy at the signal frequency, including anthropogenic ones. 3) The

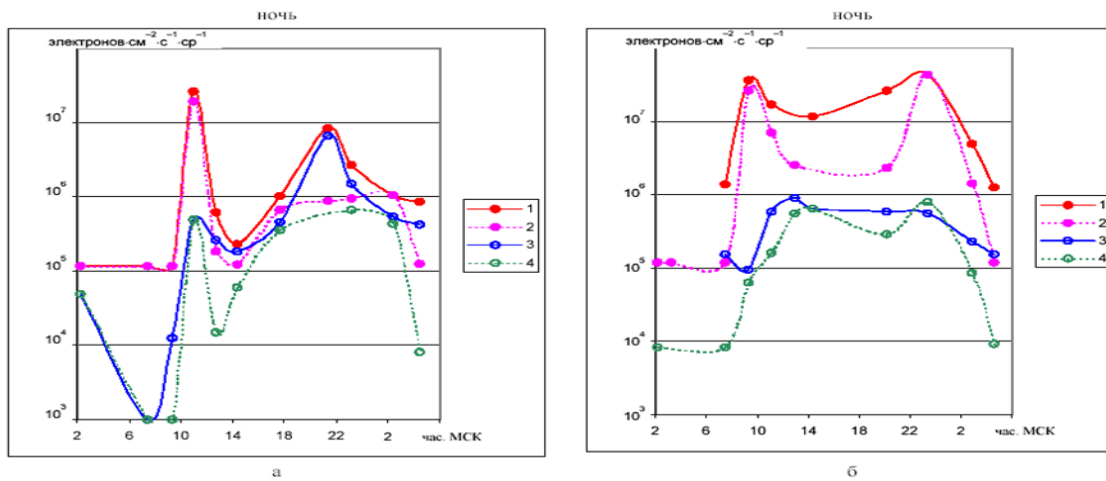


Figure 1: Variations in the intensity of electron fluxes with energies of units and tens of keV during a strong geomagnetic storm, precipitating from the radiation belts at mid-latitudes in the Northern Hemisphere, separately for the day and night ionosphere and for two regions of geomagnetic latitudes: 45-55° (a) and 55-60° (b). (According to data from the Vavilov State Optical Institute Radiometers during measurements from the Kosmos-381 satellite [34,35]). The geomagnetic storm began at 04:45, and the main phase of the storm: from 10:00 to 12:00 Moscow time.

existence of stochastic resonance represents at least a general philosophical objection to skepticism regarding the possibility of weak electromagnetic waves influencing living systems. It should be noted that due to the constantly increasing anthropogenic flow of microwaves (for several decades now, tenfold every 15 years ([27], p. 270)), the contribution of the stochastic resonance effect to microwave pollution of the environment is becoming increasingly significant!

Of course, the problem of electromagnetic influence on biological objects, including humans, is in the area of constant attention of specialists in the field of radio sciences (International Union of Radio Science - Union Radio-Scientifique Internationale (URSI)). We will cite, as an example, only reviews of the 1990s, when such studies were published in [28], p.953-1008 by the specially created Commission K for studying the biological effects of electromagnetic fields in medicine with increased attention to oncological risks. An outstanding role in the organization and direct study of anthropogenics of microwave radiation for many years belongs to David O. Carpenter, Director of the Institute for Health and the Environment, professor. In 2008, at a report in Yerevan, in connection with the 100th anniversary of Academician V. A. Ambartsumian, he provided data on the increase in the incidence of Alzheimer's disease by almost 1.5 times near a powerful navigation transmitter [29]. Previously, he participated as an editor in the famous "The Review of Radio Science", 1993-1996. In a recent publication with Causes of Cancer [30], an increased readiness for epilepsy was also noted for children.

The domestic fundamental approach to this problem is set out in the monograph [31] of A.M. Deichman: "Genetic code: from flows of elementary particles (photons, others) - to the formation of genomes and genetic code. In the context of a hypothetical mechanism of oligonucleotide biosynthesis outside the genome", <http://izd-mn.com/PDF/20MNNPM17.pdf>

The article is based on the works of Nobel Laureates, first of all J.-M. Lehn as the founder of supramolecular chemistry, G. Herzberg - who proposed, on the basis of an optical experiment, the mechanisms of Rydberg excitation of water, ammonia and methane molecules arising from proton transfer, A. Szent-Györgyi - who described the mechanisms in bioenergetics, M. Eigen - a pioneer in considering the contribution of proton transfer in

molecular biology, P. Agre - who discovered aquaporin channel, S. Haroche - with his contribution to supramolecular physics in a cavity, A. Einstein - who postulated the possibility of induced radiation. In the following sections we will provide more information on these issues.

Pandemics and the physics of solar-biosphere relations

The impossibility of measuring the true parameters of the electromagnetic and corpuscular activity of the Sun before the era of rocket and space experiments (since 1946) did not allow A.L. Tchizhevsky, an active researcher of the influence of electromagnetic disturbances of the environment on the occurrence of epidemics [8-11], to directly compare solar-geomagnetic activity and specific pandemics. In the work [32], direct indications of the presence of such a connection are presented, both using the example of the influenza virus and a number of other epidemic diseases. The duration of the influenza epidemic in each eleven-year solar period is on average four years, and the peaks within this cycle fall on both the maximum and minimum of the sunspot activity. This corresponds to modern data [33] on the same distribution of the main source of microwaves from the ionosphere - global magnetic storms.

Here we should turn to the data obtained by us back in January 1971 on the Kosmos-381 satellite with the radiometric equipment of the S.I. Vavilov State Optical Institute during the global magnetic storm, see color Figure 1, 1(2) [34,35]. Beginning in 1978, they were supported by the results of targeted visual-instrumental observations of upper-atmospheric glows from orbital scientific stations in the zone of moderate geographical latitudes (less than 51.6°) [36]. In the field of physics of solar-terrestrial relations, including in medical biophysics, these experimental results opened up opportunities for research, which is also the topic of this review.

Academician L.A. Orbeli founder in 1956 and first director of the I.M. Sechenov Institute of Evolutionary Physiology formulated the problem as follows: "The organism and the environment are something inseparable and are in unity and interaction. If we remember this and take into account the fact that the entire course of development of certain functional relations took place in a certain environment, eternally changing, eternally affecting living organisms, then it becomes clear that not

a single function could develop and undergo certain changes otherwise than under the influence of and depending on those environmental impacts to which it was constantly exposed... We have to take into account both internal factors emanating from the organism itself in the form of interaction of its individual parts, and external factors" [37, p. 61]. In [38], p. 129, it has been researched that "The activity of adenosine deaminase and dipeptidyl-peptidase, which are targeted at during certain pathologies has been studied, and the low/ high-molecular ratio of ADA1 in synovial fluids of patients with rheumatoid and reactive arthritis, Bechterew's disease and ankylosing spondylitis have been determined. In the cases of gout and osteoarthritis the level of low molecular form was negligibly. To compare the citrullination state as diagnostic indexes, the ADA 1 isoforms have been purified from synovial fluids of patients with different arthritis using gel filtration and ion exchange chromatography". This results are presented in [39,40] and are relevant to the topic of the review, since they are important for analyzing the situation regarding the causes of a number of serious diseases. 20 years earlier, the first similar results were obtained at the Kazan Medical Institute, see references [31,32] in our article [33], for high solar-geomagnetic activity. It is interesting to trace the experimental and theoretical prerequisites for the need to take into account the approach of Academician L. A. Orbeli, the founder and first director of the Sechenov Institute of Evolutionary Biochemistry, using the example of the exogenous approach to the emergence and development of epileptic seizures, since more than 50 million people in the world currently suffer from epilepsy. Despite the fact that the first results on this topic are more than a century old, they have practically fallen out of the paradigm of modern concepts of pathology and methods of combating epilepsy. In our opinion, the reason for this is the fascination with thermodynamic considerations and limitations. However, according to [41], p. 31: "... thermodynamics tells us only whether a given reaction is possible or not, but it tells us nothing about the nature or mechanism of this reaction." For example, in [42], with the classical approach, section 14.4, to the analysis of the causes of disturbances in brain activity at the very beginning of an epileptic seizure, the change in EEG is quite adequately described (within the framework of self-organization and coordinated behavior of an ensemble of neuronal cells when the linear stability of a steady state is not maintained due to endogenous factors). But it is also noted there that self-organization can also arise in some stable systems if they are affected by external fluctuations [42], p. 354. Similar results using activated water were obtained in [43,44]. In this regard, more modern concepts are relevant [45], p. 497, on the role of opening water channels - aquaporins by P.K. Agre [46], p. 4279: "... in pathological conditions such as cerebral ischemia and epilepsy." Much attention is paid to the pathology of convulsive seizures in a recent monograph [47] in connection with cardiocerebral disorders and intracellular changes. Here it was revealed p. 243 that convulsive states provoked by factors of different nature cause equally severe hemodynamic changes (during the movement of blood through the vessels) and, which is important for our further consideration, are accompanied by a long-term decrease in the content of macromolecules, presumably associated with a change in the permeability of neurons for ions and water, p. 270. From this, the conclusion is drawn: "the mechanisms that carry out water transport through plasma membranes play a central role in the physiology of the brain." Thus, modern medical biophysics of convulsive epileptic states [47] emphasizes the importance of macromolecular structures, and aquaporin channels in neuronal membranes are then capable

of being an obstacle to the penetration of even the simplest supramolecules.

Indeed, according to [48], p. 405, "It is now generally accepted that liquid water is a collection of water molecules united into a single network. Proton exchange is constantly occurring the protons of liquid water are therefore largely socialized, forming a subsystem with high mobility. The existence of this subsystem in high-purity water determines its electrical conductivity: the latter cannot be explained if we consider that water is only a collection of inert water molecules."

From supramolecular chemistry to microwave supramolecular physics

In the monograph by J.-M. Lehn [49], arguments were already given in favor of considering Rydberg electron states, p. 22, see [50]. Also there are proposals [49] on the need to consider "molecular protonics" as the most important process for biophysics. Thus, according to [49], proton transfer is of fundamental importance in the bioenergetics of a living organism, directing transport processes and the synthesis of ATP - adenosine triphosphoric acid - a supplier of chemical energy for biochemical and physiological processes in the body. In his invited online lecture at the St. Petersburg Forum of Nobel Laureates on June 26, 2015, J.-M. Lehn [51] focused on the need to take into account the cosmic influence.

To a certain extent, supramolecular chemistry is related to the discovery by R.K. Agre [46] of the aquaporin channel in biological membranes, which allows water to move, excluding, for example, the H_3O^+ form [45]. Here it is worth recalling what an important role is given to the Rydberg spectra of these ions in [24].

In [52,53] the questions of the behavior of Rydberg states during interaction with microwave radiation in a closed cavity were consistently investigated. This is important for the biophysics of the human body, since its experimentally registered microwave radiation is considered thermal [54]. This question was discussed by us in [55] based on the conclusions of [56], p. 79. It should be noted that for the first time in the microwave range we took into account A. Einstein's postulate on induced emission in [33].

We have been discussing the presence of the microwave factor in nature since 1994 [2,4,5] and are talking about sporadic microwave emission of the earth's ionosphere, especially strong during magnetic storms and during solar flares.. In recent years, we have published, precisely based on the use of the proposed mechanism of supramolecular physics, studies of the role of solar flares and, especially, global magnetic storms in the development of pathology in the field of rheumatoid and reactive arthritis, oncological, viral and neurodegenerative diseases.

The mechanisms of the impact of external electromagnetic fields on the aquatic environment of organisms, before our work, the consideration of the assumption of A. Szent-Györgyi, formulated more than 60 years ago, remained relevant, that the interaction between molecules can occur without direct material contact, either through energy bonds, or through an electromagnetic field, which, thus, appears as a matrix of biological reactions [57]. Thus, in fact, a physical solution to the problem raised in [57] is proposed, taking into account the influence of electromagnetic fields on the aquatic environment of a living organism in biology and biophysics. Our approach involves both

the water of the organism and the electromagnetic (micro-wave) field of the environment, primarily of ionospheric-cosmic nature. The forecast is known [58] in order to find an approach to the central problem of biology, we must expand our ideas in two directions: submolecular and supramolecular; the same author in [58] stated, that at present, humanity suffers most from the so-called “degenerative diseases” which we do not understand and with which we, therefore, can do nothing. In his last book from the remarkable triad, the same author [58] devoted attention to the problem of cancer through consideration of the role of the electron in biology this is relevant today not only for oncology, but also for viral infections HIV and Covid-19, as well as epilepsy, which affects up to 50 million people worldwide.

Attention to experimental evidence: Attention to experimental evidence of the presence of Rydberg - type excited levels in biological molecules was paid even in [59]. And it was noted that “the. Theory ignores Rydberg excitations.” The table presented in [59] contained data for vital biomaterials, for example, DNA, blood cells, oligopeptides, glycopeptides, chloroplasts, etc. It should be emphasized that these processes can actively proceed both in the gas phase and in liquids. M.B.Robin [60] confirmed that the Rydberg states are recorded in the absorption spectra for both water vapor and in condensed media (liquid water and ice), while the values of the absorption cross sections remain almost unchanged. Moreover, M. Eigen and L. De Maeyer [61] investigated the proton transfer in water due to hydrogen bonds with the formation of complex hydrated ion associates with the participation of water molecules and concluded that the results could be used in biological applications, and in [62] it was proposed to take into account at the very beginning of evolution, i.e. in the process of the emergence of life, the possibility of the emergence of the first structurally stable macromolecules from protein-like substances.

The following circumstance is important to consider the contribution of electromagnetic radiation to the bioenergetics of a living organism: in highly excited (Rydberg) states, including in clusters involving water molecules, induced radiation occurs in parallel with the absorption of microwave quanta in the same range with a significantly higher probability than emission in spontaneous electric dipole transitions (see, for example, [12]). This article attracted increased attention because it provided an explanation for the concepts introduced by A.G. Gurvich in the microwave range: “biofield” and “mitogenetic rays” [63]. This means that the induced microwave radiation that occurs when a flux of quanta of an external electromagnetic wave passes through a liquid medium participates in further acts of excitation of a Rydberg electron. Therefore, there is reason to take this process into account in the power engineering of biological reactions, because the induced radiation quantum has the same frequency and direction of motion as the primary one and, therefore, participates in the processes of the occurrence of neutral water-containing associates in the framework of the same scenario of supramolecular physics.

On the natural causes of “Sporadic Irreproducibility” in biophysical Experiments

The maximum microwave fluxes from the ionosphere that sporadically occur during global magnetic storms are an important additional factor in the combined effect of electromagnetic radiation on the biosphere, the intensity of which can reach $\sim 10^{10}$ W/cm² [64], which exceeds, for example, the human body’s own microwave radiation (which is believed to be of

thermal origin) [54].

The effect of stochastic resonance of the ionospheric emission flux, continuous over the entire spectral range, with anthropogenic microwave sources (electronics, cellular communications, positioning) at operating frequencies, as well as with sources of thermal radiation (in the millimeter range) of the environment and personnel is also predicted. The microwave emission flux from the ionosphere was measured in dozens of experiments from ground-based radiophysical observatories, primarily during periods of solar flares and magnetic storms. It is important to emphasize that even in the main phase of the global magnetic storm, i.e. when observing the brightest polar auroras, the flux reaching the biosphere is lower than $\sim 10^{10}$ W/cm² [64], which causes only weak, non-thermal forms of impact on living organisms. Obviously, external microwave radiation in the absence of control over microwave fluxes from the disturbed ionosphere can be the main factor responsible for long-term observations of “irreproducibility” effects in a number of biophysical experiments [58]. This refers to sporadic “irreproducibility”. Thus, we follow the approach: “irreproducibility does not mean the unreality of the object, irreproducibility makes sense only in relation to the time interval of the study” [48], p. 531. It was emphasized that the problem of reduced reproducibility of non-thermal (i.e. non-heating, not leading to an increase in the temperature of living tissue - L.B. and S.A.) effects is important; in the presence of many generally recognized factors of non-reproducibility, its nature has not yet been studied” [48], p. 578. Although what was said referred to small effects in magnetobiology, it is also important in interpreting low-dose phenomena. According to our study [58], the phenomena recorded by Benveniste’s group can be fully explained by the uncontrolled effect of ionospheric microwave emissions in these experiments, i.e. this is a typical “sporadic irreproducibility”!

Indeed, according to [48], p. 405, “It is now generally accepted that liquid water is a collection of water molecules united into a single network. Proton exchange is constantly occurring: The protons of liquid water are therefore largely socialized, forming a subsystem with high mobility. The existence of this subsystem in high-purity water determines its electrical conductivity: the latter cannot be explained if we consider that water is only a collection of inert water molecules.”

Conclusion

We have been discussing exactly 30 years ago: (7-11, November, 1994 [2]) the presence of the microwave factor in nature:

For this purpose, they proposed and substantiated the need to take into account a new factor-agent in the physics of solar-terrestrial relations;

And are talking about sporadic microwave emission of the earth’s ionosphere, especially strong during magnetic storms and during solar flares;

In this final Review we basically finish our topic in this direction of medical biophysics, citing all the main (see also the first article [12]), the results of recent years were published by us, just based on taking into account this approach, the study of the role of solar flares and, especially, global magnetic storms in the development of pathology in the field of rheumatoid and reactive arthritis, oncological, viral and neurodegenerative diseases.

These results were obtained with the participation of the

head of the synoptic program of the US National Solar Observatory, Dr. A.A. Pevtsov. Again we used our mechanism, the development of which began in 1994 and manifested itself in, apparently, a sign of a weakening of the current helioepidemic COVID situation. In such a situation, the main electromagnetic pressure can be exerted by anthropogenic microwave smog of the cellular communication system. In this regard, Academician of RAS A.G. Chuchalin says: "Man has built the modern world, changed his entire environment... turned out to be very vulnerable to what he himself created. And first of all, this concerns his immune system." [32].

The article analyzes the works of Nobel Laureates, first of all J.-M. Lehn as the founder of supramolecular chemistry, G. Herzberg - who proposed, on the basis of an optical experiment, the mechanisms of Rydberg excitation of water, ammonia and methane molecules arising from proton transfer, A. Szent-Györgyi - who described the mechanisms in bioenergetics in living systems, M. Eigen - who is actually a pioneer in considering the contribution of proton transfer in molecular biology, P. Agre - who discovered aquaporin channel, significantly enriching our knowledge of neuropathological processes, S. Haroche - with his contribution to supramolecular physics in a cavity, since we have shown that for microwave radiation the human body can, in accordance with the experimentally determined thermal character of its microwave radiation, be considered to be in thermodynamic equilibrium, A. Einstein - who postulated the possibility of induced radiation. It turned out that by 1980, practically simultaneously, and as a result of the analysis of the data of our own optical experiment in the group of G. Herzberg, and J.-M. Lehn within the framework of the newly developed supramolecular chemistry, the possibility of generating supramolecules, for example water, in electronic extremely highly excited Rydberg states with increased sensitivity to the microwave radiation flux was revealed. Earlier in the previous article in JCIMCR, 2022 [12], we took into account such data when analyzing the concepts of "biofield" and "mitogenetic rays" introduced in the works of A. G. Gurvich about a hundred years ago in connection with studies of malignant mitosis.

We took into account the pioneering experimental and theoretic works, published in 1980 -1985 years, in which the possibility of the formation of "polyatomic Rydberg molecules" in such cases was found. Here we used the analogy with molecular protonics considered for the biomedium within the framework of supramolecular chemistry. According to our study [65,66], the phenomena recorded by Benveniste's group can be fully explained by the uncontrolled effect of ionospheric microwave emissions in these experiments, i.e., this is a typical "sporadic irreproducibility"!

We are pleased to note a unique result of Movsisyants SA, Kaidanova LA. Adaptive regulation as a method of active management of pathological bioelectrical activity of the brain in epilepsy, L.: 1980, Inst. Exsperiment. Medicine, [67], showing the possibilities of using self-regulation of the state of one's organism by an individual using the radiophysical feedback method [68].

In the Russian Federation, in connection with the concerns expressed recently by both teachers and parents, as well as with the opinion of the country's Prosecutor General's Office of the Russian Federation, already two years ago, and the City Parliament of St. Petersburg adopted an Appeal to the with a request to ban the installation of mobile cellular telephony repeaters

near hospitals, kindergartens, etc. It is planned to develop biophysical studies of the consequences of the cumulative microwave impact both within the framework of heliobiology (at the present stag of the decline in the level of solar-geomagnetic activity), and taking into account the resonant mechanisms of increasing anthropogenic exposure at the frequencies used, with the organization of local control of the level of exposure to microwave sources, and/or taking into account the data of the world network for monitoring the current solar-geomagnetic disturbances.

However, according to Radio Russia, October 1, 2024, instead of the recommended intervals for the total use of smartphones and mobile phones (for high school students 80-120 minutes a day, and for younger students - up to one hour), schoolchildren are busy with them up to 6 hours a day. We have tried our best to adapt all our borrowings from foreign sources for the English-speaking reader, while revealing the acute moments in previous publications. We have managed to show the role of Nobel Laureates, the importance of A. Einstein's postulate on the induced emission, and supramolecular physics of Rydberg states in medical biophysics. This means that the induced microwave radiation that occurs when a flux of quanta of an external electromagnetic wave passes through a liquid medium participates in further acts of excitation of a Rydberg electron. Therefore, there is reason to take this process into account in the biological reactions, because the induced radiation quantum has the same frequency and direction of motion as the primary one and, therefore, participates in the processes of the occurrence of neutral water-containing associates in the framework of the same scenario of supramolecular physics. The ongoing study of the response of living matter to variations in the microwave flux of ionospheric-cosmic nature is important for progress in solving fundamental problems of bioenergetics and in medical applications - in electromagnetic radiation therapy.

Declarations

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This is to confirm that there are no conflicts of interest among the authors.

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