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Chapter 15

A LIFE DEVOTED TO ASTRONAUTICS: DR. OLGIERD WOŁCZEK (1922-1982)*

M. Subotowicz†

BIOGRAPHICAL REMARKS

Dr. Olgierd Wołczek died on August 24, 1982 in Warsaw. From 1971 he edited the scientific-popular Polish bi-monthly *Astronautyka* and also from 1973, the scientific journal of the Polish Astronautical Society (PAS) *Postępy Astronautyki* (Progress in Astronautics). He was one of the founders of the PAS (1954), then its General Secretary for 10 years and later the deputy of the President of PAS for years. He was very active also in the field of scientific research in astronautics and space physics. The scope and breadth of his knowledge can be seen in his 22 books and 34 papers on astronautics and space physics, and 10 books and 14 papers on nuclear physics and other subjects. He published also several hundred papers in popular journals, and took part several hundred times in radio and television programs.

The variety of subjects in which Dr. O. Wołczek was interested, the richness of his mind and his deep humanity, can be seen even in his three papers prepared for the 33rd IAF Congress. They were written on novel aspects of cometary research, on problems of extraterrestrial influences on biological evolution, and on the importance of astronautics for material, spiritual and biological development of mankind. His PhD-degree (1963) was based on his research in nuclear spectroscopy. But astronautics became the main interest and aim of his life.

In the first half of 1954 I published in the Polish scientific-popular monthly *Problemy* the article on astronautics and made the appeal that "It is time to institute the Polish Astronautical Society". The first who supported my appeal was Dr. O. Wołczek. During the meeting at the Institute of Physics of the Warsaw University in December 1954, several young physicists decided to institute the Polish Astronautical Society (PAS). Dr. O. Wołczek was among the several charter members of PAS. He was the most active member of the PAS in the organizing and popularizing scientific work. He wrote in 1976: "I was deeply interested in astronautics as a 9-

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year-old boy. The first step to participate in cosmic research was to institute PAS. Together with Professor Subotowicz we initiated PAS three years before the first Sputnik."

Figure 1 Dr. O. Wołczek in his office.

When doing the work of the main specialist in the office of the government's plenipotentiary for nuclear energy, Dr. O. Wołczek wrote that he was looking "for the possibility to be engaged completely in space research." All his scientific activity in nuclear physics was taken "as the preparation for space research."

In the several last years Dr. O. Wołczek worked in the Air Medicine Institute. There he could spend all his time working on space research. In space activity he found the sense and joy of his life. One could see this in his scientific work, in his enormous knowledge on different problems in astronautics, in his engagement in

social work connected with PAS, in his joy in popularizing astronautics in his books, in radio and television talks, in hundreds of the popular articles he published in the PAS bimonthly *Astronautyka*, and in his innumerable popular lectures.

He received international recognition while sponsoring very actively international cooperation in astronautics. Dr. O. Wołczek was a corresponding member of the International Academy of Astronautics (IAA) in Paris, and as a member of several committees of the International Astronautical Federation (IAF) and IAA, he took part in more than 20 IAF Congresses as the author of interesting scientific papers. He was an honorary member of several foreign astronautical societies and very well known among the people dealing with astronautics. His books were translated into English, Russian, French, Hungarian, German and Japanese languages. He was invited to present lectures in Vienna, Berlin, Dresden, South Dakota (U.S.A.), Winnipeg (Canada), Kaluga (U.S.S.R.) and Munich (F.G.R.).

Dr. O. Wołczek's best books, in his opinion, were: *Isotopes and Men's Duty* (1955), *Secrets Taken from the Sky* (1962), *Interplanetary Flight* (1973 and 1980), *Birth and Development of the Solar System* (1979), *M. Skłodowska-Curie* (1975), and *Cosmic Scenes of life* (1982).

For seven years he was the chief editor of the *Proceedings of the IAF Congresses* published in cooperation with Gauthier-Villars, Dunod and Pergamon Press by Polish Scientific Publishers in Warsaw.

His scientific production is contained in 15 papers on nuclear spectroscopy and 34 papers on space physics, dealing with planetology, evolution of matter in the Solar System, nuclear propulsion rockets, influence of cosmic factors in the origin and evolution of living organisms, as well as the impact of astronautics on the further development of science, engineering, and civilization.

Dr. Olgierd Wołczek, born on April 3, 1922 in Toruń (Thorn), started his education in Katowice in Silesia. He took part in the second World War in September 1939. After being arrested and then released by the Gestapo, he spent all the occupation in Czestochowa, where he finished the secret secondary school. From 1945 until 1949 he studied chemistry at the Technical University in Łódź. In his diploma work he dealt with the problems of the separation of uranium isotopes. From 1949 until 1955 he was an assistant at the Warsaw University, and from 1955 until 1968 he worked in the Institute of Nuclear Research. From 1968 until 1976 he was engaged as the main specialist in the office of the governments plenipotentiary for nuclear energy. From 1976 until his death he worked at the Air Medicine Institute in Warsaw.

He was very laborious and all his passion in work he devoted to astronautics. During his scientific work in experimental nuclear physics he lost one eye about 30 years ago, but this could not stop his activity in astronautics. Being engaged in nuclear physics he devoted his knowledge to astronautics. He dropped his job at the Nuclear Physics Institute, and, stimulated by his interest, started to work in astronautics and space physics. He was the only author of his books and papers; none were written as a common paper or book with another author. His knowledge of very different subjects in astronautics was enormous. He was very familiar with

many important topics in space physics, astronomy and even space biology. In some subjects, e.g., planetology, he was the best specialist in Poland.

Dealing with almost all astronautics and space physics on a popular level, his scientific activity of a qualitative character can be placed in the following four subjects:

1. Nuclear energy in rocketry,
2. Impact of astronautics; various non-selected problems in astronautics,
3. Evolution of matter; planetology,
4. Life in the Universe.

During his several last years Dr. Wołczek dealt mainly with subjects (3) and (4) mentioned above. We shall review the scientific papers of Dr. O. Wołczek according to this list of subjects.

Independent of his engagement in the physical sciences, I would like to stress the role of humanism in Dr. Wołczek's creations and his personality. His knowledge in science, physics, chemistry and astronomy was very impressive. But his erudition in classical education, in literature, arts, and music was also outstanding. He liked mountaineering. He enjoyed traveling as the means to become acquainted with other people and their work. He knew activitely several European languages (English, Russian, German and French) and made himself understood in Italian and Spanish. He saw in the social and philosophical consequences of astronautics the synthesis of two important trends in the development of mankind: the natural, or scientific, and the humanistic ones. He represented the contradiction in the narrow specialization in science. He was thinking in human affairs on the scale of the planet or on even a greater scale. Thanks to astronautics it will be possible to conquer the Solar System, to realize the centuries-old dream of the space visionaries. Dr. Wołczek believed that this would be the first step only. The following steps will be the penetration of mankind into the Galaxy, traveling to the stars. It will be the new stage in the evolution of the human species, the stage of the *homo galacticus*. Astronautics is the prerequisite of the development of the human civilization and culture. Dr. Wołczek wrote: "The prolonged stay of the human being in space will deeply influence not only his mind but also his body. . . . The intense influence of deep space must induce extraordinary bodily, mental, and spiritual changes in human beings. If man will withstand the ruthless pressure of the galactic conditions and defy the infinity of space, he will emerge totally altered - as a new man, *homo galacticus*."

All who met and were stimulated by this dynamic man, Olgierd Wołczek, mourn his untimely death in his 60th year. Astronautics was for him not only a way of life, but its greatest adventure.

SCIENTIFIC ACTIVITY

Nuclear Energy in Rocketry

In two papers Dr. Wołczek proposed to build a cold atomic reactor instead of a thermonuclear one and to use it in a nuclear rocket.[1,2] In the thermonuclear reactor, the Coulomb barrier between the hydrogen isotopes will be overcome thermally at temperatures higher than 1.5×10^7K. In the case of catalytic synthesis, the nuclei can be subjected to synthesis through mu-mesons. The radius of the mu-meso-atom is 20 times smaller than that of the ordinary hydrogen atom. These meso-atoms can be close enough to realize mutual synthesis in low-temperature meso-protonium, -deuterium, and -tritium. This project requires large sources of mu-mesons, produced in linear accelerators. The author discussed the shape and performance of the fusion reactor in the space rocket. Its main disadvantage is the short life-time of the meso-atoms.

In one paper, Dr. O. Wołczek dealt with the problem of the exploitation of nuclear energy for experimental purposes in cosmic space.[3] Artificial sources of this energy--explosive and non-explosive--could serve studies concerning cosmic space properties by determining the matter present in it and by permitting the exploration of the properties of this matter. They permitted also definite exploration of meteoric swarms. Dr. Wołczek proposed to form a special cosmic laboratory that would perform work on experimental astrophysics and star models with respect to artificial sources of nuclear energy. The laboratory would begin with the practical exploitation of nuclear energy for the generation of electric energy on the Earth's surface, and then extending it to the problem of so-called anti-matter and its properties.

Various Problems, Impact of Astronautics

The main interest of Dr. O. Wołczek in astronautics was connected with (a) application of nuclear physics achievements in rocketry, (b) planetology and physical evolution of matter, and (c) life in the Universe. This does not mean that other topics of astronautics were outside his interest. Let us present his several achievements in dealing with the free radicals in rocket propulsion, with technical realization of subgravity and weightlessness, with the methods of measurement of the distances of space rockets, and with the impact of astronautics on science, technology, human civilization and culture.

In another paper, the possibilities of using nuclear and corpuscular non-nuclear radiation for producing free radicals were examined.[4] "Free radicals" mean atoms or groups of atoms in the metastable state. The reactions between free radicals are accompanied by considerable release of energy. The amount of energy is often one range of magnitude greater than the corresponding amounts of energy released in the most advantageous chemical reactions, e.g.: $H_2 + 1/2\ O_2 \rightarrow H_2O$ + energy released 3,810 cal/g (chemical reaction) and $2H \rightarrow H_2$ + energy released 51,210 cal/g (reaction of free radicals). The author

considered also the use of beta and alpha rays from isotopes and radiation produced inside a nuclear fission reactor to produce free radicals. The proposed method would seem to be of some practical value.

Two papers considered the technical realization of subgravity and weightlessness on Earth and under full effects of the force of gravity.[5,6] He presented a comparatively simple method using centrifuges for devices operating on the same basis. All such devices should be stationed in a vertical position so that their axis of rotation would be parallel to the surface of the Earth. In this way the inertial (centrifugal) force of rotation is added to the gravitation force alternatively weakening or strengthening its effects. Practical methods were given for realization of rapid transitions from multi-g field to states of subgravity and weightlessness and vice versa, with the aim of conducting research work in space techniques and medicine. He proposed the construction and exploitation of certain apparatus for producing intermittent subgravity and weightlessness lasting for longer periods of time, on the order of hours and more.

In one paper, Dr. O. Wołczek proposed to use a simple television check altimeter for use in cis-lunar space.[7] This distance of the satellite circling the Earth at a height about 400 km would be measured with the precision of approximately ±160 m.

In several papers, Dr. O. Wołczek discussed important contributions of outer space research to the development of science and technology, due to the need to overcome extreme physical conditions which do not occur on the Earth. Direct access to outer space was a fact of basic importance.[8-10] Astronautics has brought about large-scale research on many phenomena connected with the preparation for and carrying out of outer space flights; fundamental technical problems have been solved by the introduction of new plastics, methods, construction, apparatus, etc. Outer space in the solar system and its heavenly bodies are subject to direct exploration.[8]

Space research required particularly vast development of science and technology which could not have been realized without it. The progress has contributed to the development of civilization, which is, however, conditioned by further development of astronautics.

Astronautics is of fundamental importance to the study of matter, which outside the Earth appears in forms other than on our planet.[9] The problem is inseparably connected with the mystery of life and possible existence of intelligent creatures other than men. There exists the need to abandon anthropomorphic and geomorphic habits. The Earth constitutes merely a trivial fragment of space, for which it cannot serve either as a pattern or a point of relation. The start of man to step over the space threshold is the epochal event in the history of mankind. The long and sustained stay of human beings in space and on other celestial bodes can, and probably will, have profound repercussions on the mentality and development of local and more general civilizations and cultures. Therefore, problems of the evolution of *homo cosmicus* and *homo galacticus* were presented in some detail and the impact of such evolution on mankind was outlined by the author. Dr. Wołczek

was of the opinion that true progress, the improvement of mankind, is connected more with mental and ethical activity than with structural and physical changes of human organisms.

Spaceflight involves the cooperation of many institutions, many factories, and many people; it developed not only as a result of an international competition. It implies something mystical; man perceives infinite depth and the vastness of space rousing his imagination. It is something totally new, something extremely stimulating. Humanity cannot develop further without access to space. Penetrating into the cosmos, man will look from the most wide perspective at matter, at the whole Universe, at the ultimate fate of mankind. Involved in this exceptional situation he cannot remain internally unchanged.

Evolution of Matter, Planetology

The problem of matter in the Universe, its evolution and shape in various conditions was the main scientific interest of Dr. Wołczek during at least two decades. The new possibilities of the investigation of matter allows deep insight into its different shapes and forms in extraterrestrial conditions, sometimes in extreme conditions. Four principal interactions determine all organization of matter: gravitational, electromagnetic, weak and strong interactions; their relative strengths are: 10 : 10 : 10 : 1. Weak interactions are responsible for the radioactive decay of nuclei and that of elementary particles. Strong interactions determine the existence of the nuclei and their interactions with mesons and baryons. The electromagnetic interactions determine the processes in and with the electronic shells of atoms and molecules. It means that these interactions determine the properties of gases, plasma, minerals and living matter. New information on matter, its distribution and its dynamics, is delivered now by astronautical means: space, interplanetary, Moon, planetary and galactic probes. We understand better the inertial structure of the Earth and its atmosphere. In one paper, Dr. Wołczek described results of the investigations of the Moon and planets, and discussed the cosmogonical implications of this research.[11] It is important to elaborate the perfect methods of the remote, automatic chemical analysis of matter on various planets and in interplanetary space by using specialized probes.[11-13]

In other papers, Dr. Wołczek dealt with the problems of evolution of the solar system.[15,16] He discussed the size of the Solar System and forces responsible for its evolution, the contemporary and primary distribution of matter. There are some peculiarities of the process of organization of matter in the primary circumsolar nebula. The aggregates were formed from dispersed matter. The role of the solar wind and magnetic field in the early Solar System was described, as well as the time of formation of planets and coupling between planetary masses and orbits, their longevity and that of the whole Solar System.

One paper discussed various theories of the origin of Solar System.[16] Several proposed extraterrestrial experiments that could serve as the models of the processes in the interior of the stars, e.g., thermonuclear energy production. There would be necessary the energy supply, its concentrations (lasers), plasma generators, diag-

nostic and measuring apparatus. The main energy source would be the Sun. Plasma could be contained by magnetic and electric fields. Principally it would be possible to realize experiments in very high temperatures and densities of matter.[16]

Two papers discussed the highlights of the evolution of exploration of matter of the Solar System by space techniques.[17-18] The morphologic and topographic investigations of the planets enable better recognition:

1. Of the structure and dynamics of the planets' surface and its connection with history of this and other planets,
2. Of the influence of the atmosphere, cosmic environments and Sun on this structure, and dynamics of the climate in the past, now and in the future.

It discussed the role of cosmo-chronological measurements, the search for life, and underground soil investigations. The up-to-date (1975) probes have many disadvantages (reliability, electronics, energy supply, radioisotope thermoelectric generators, energy conversion rate).

Especially important was the investigation of terrestrial planets and their surface morphology.[19] Dr. Wołczek discussed other research goals, such as investigations of surface layers and factors which were and are shaping the upper strata of planetary crusts. Subsequently Dr. Wołczek stressed the very important role of simulators.[19] In connection with Mars exploration, emphasis on dust interaction with landers and their instrumentation was mentioned.

The morphology of the Martian surface indicated that in the distant past a denser atmosphere containing appreciable amounts of water existed on Mars. Evidence was found that in the period earlier than 600 million years ago the rate of surface erosion was very great. On the surface of Mars, various channels exist which could be formed by the action of fluid water. In one paper, Dr. Wołczek expressed the hypothesis that although irreversible decomposition of great quantities of water could take place in the past, considerable amounts of it may persist now trapped in the form of permafrost and in polar caps of Mars.[20] There are some indications, of the existence on Mars, of surface transient atmospheric precipitations and rivers, influenced by internal (volcanic and tectonic activity) and cosmic factors (changes of Mars rotational axis inclination, the Sun's luminosity fluctuations, penetration of the Solar System into condensations of interstellar matter).

Consequently, developing his knowledge in planetology, Dr. Wołczek discussed the contemporary view of terrestrial planets.[21] Their overall characteristics, including the Moon, testify that all these bodies constitute a very distinct and well defined group from the very beginning of their formation: in a relatively limited space and in the vicinity of the central star of the Solar System. Due to their relatively small mass they could not retain hydrogen and helium, constituting the bulk of the system's matter. These planets were formed from materials of relatively high condensation temperature, mainly iron and silicon compounds. The extent of the interior planetary activity on the surface and in the atmosphere depended strongly on the size and mass of these celestial bodies. Solar radiation, chemical composition, magnetic and electric fields, internal activity and the presence or lack of life shaped the evolution of the atmospheres and the surfaces of these planets. Their

evolution was affected by the surrounding present and past medium, the central star, the whole Solar System and the rest of the Universe. All these phenomena could influence also the evolution of life. It is a typical feature of Dr. Wołczek's treatment that he analyzed the phenomena in their mutual interaction and dependence, even on the scale of the whole Universe.[21]

Recent investigations of extraterrestrial matter were performed outside the Earth using almost exclusively passive means with some exceptions (meteorites, samples of lunar material). Such means delivered much information on the chemical constitution of extraterrestrial matter, physical state and structure (mineral, petrological, etc.), field characteristics (magnetic, electrical, gravitational), radiation, structure and dynamics on the surface and interior of celestial bodies, and possible occurrence of life. But we have no data on the evolution of foreign matter, on dense and opaque tropospheres of many planets, on boundary layers between atmospheres and liquid parts of Jupiter and Saturn. Dr. Wołczek proposed the use of active means in these investigations, such as: sources of intense coherent radiation, entry and impacting pellets, penetration and impact probes, aerostatic and aerodynamic devices, electrical discharges, chemical and nuclear explosions, enabling acquisition of unambiguous information directly at the site being the aim of the investigations.[22]

Dr. Wołczek described penetrators and other terradynamic devices to investigate effectively the upper layers of the planetary crusts (Mars, Venus, Moon).[23] He presented the possibility of investigation of physico-mechanical, thermal, magnetic and electric properties and of examination of composition, structure and dynamics of the subsurface crust layer by using the terradynamic devices, especially on Venus.

The present knowledge of the Jovian planets and their natural satellites is far from satisfactory. Dr. Wołczek proposed complex single-planet missions and stationary planetary orbiters, equipped with advanced instrumentation and with many penetrating devices enabling the execution of numerous investigations in the planetary atmospheres and on the surface of the planet.[24] For investigation of atmospheres, free-falling probes and self-propelling probes were recommended. Grenades would enable investigations of deeper atmospheric layers. Investigations of Jovian planets' moons may be executed by means of soft-landers. Extensive experimental and computational work should precede the practical realization of the proposed Jovian planetary probes .[24]

In one of his papers, Dr. Wołczek suggested a mission to the asteroids.[25] Their direct investigation with the aid of astronautical means may contribute considerably to the solution of several fundamental problems concerning the Solar System and its evolution. Probably unmanned exploration of the asteroid belt will be feasible in this century. A specially equipped probe for this mission was proposed.[25]

Dr. Wołczek presented planets as dynamic systems proposing more precise definition of planets, where the criterion of mass is supplemented by dynamic attributes of the celestial bodies.[26-28] The author mentioned three dynamic systems: internal, planetary or *global*, *atmospheric* and *magnetospheric*. The fourth one is the

biospheric system. These four systems create one dynamic all-planetary system. There exists the hierarchy of these four dynamic systems, a very close feed-back and interdependence among them leading to the creation of a superior dynamic planet-wide system. The author discussed the birth and evolution of these dynamic systems on terrestrial planets.[26] These systems develop under the influence of internal and cosmic factors.

The role of boundary layers between the above systems was discussed.[27] Boundary layers never behave as passive interphase division but play an active role in the conservation of the separate character of the above systems and in their evolution. The boundary layers function as filters between planetary systems, as zones of coupling of different phases and sometimes as barriers. They protect media and systems enabling their dynamic stabilization. On the Earth the magnetospheric, ozonospheric and lithospheric barriers are the most important. There exists some hierarchy between the barriers. The existence of barriers was a precondition of the rise and evolution of the biospheric system.[27]

Dr. Wołczek called our attention to the fact that dynamic planetary systems are not closed, but open--undergoing continuous and fluctuating influences from the outside. The phases formed in these systems are of the dissipative type.[27] The formation and evolution of these phases in the Solar System from its beginning were discussed. The biosphere has particular character with its self-organization and evolution processes. In Dr. Wołczek's opinion there was some advantage in analyzing the past and future of the Solar System based on general assumptions about the dynamic systems in our planetary system.[29]

In connection with the above idea of dynamic systems, new research methods and devices were proposed which will enable the creation of complex and more truthful pictures of planets as dynamic systems.[30-31] Dr. Wołczek emphasized the extreme scientific value of direct investigation of foreign planetary systems with the aid of interstellar probes.[30-31] He discussed the nature of extra-solar planets and methods of detection of extra-solar planetary systems. The earliest interstellar flight will occur in about 30-50 years from now.

Dr. Wołczek's last paper dealt with planetology and novel aspects of cometary research, presented during the 33rd IAF Congress in Paris.[32] The origin of comets is far from being elucidated. The complex internal dynamics of active comets awaits a detailed explanation. What is the nature of the residual material remaining after the outgasing of the cometary nucleus? There is organic matter that could play a particular role in the origin and development of life on celestial bodies. It would be very important to deliver to the Earth the material from different parts of a comet. The investigation of this material will yield very valuable information pertaining to a biogenic synthesis of biologically important organic compounds and the origin of life.

Some meteoroid streams can be identified with comet remnants or with debris lost by comets along their paths. Studying cometary material is connected with the investigation of selected meteoroids. But Dr. Wołczek believed capture of larger pieces of cometary material would be of principal importance.

Life in the Universe

The problem of life in the Universe was, together with the planetology, the main topic of Dr. Wołczek's interest. We present now the main ideas of his several papers dealing with the problems of life. On the search for life on Mars, Dr. Wołczek pointed out that analysis of the appearance of life and its development outside of the Earth is conducted by investigating the conditions associated with the birth of life and its evolution on the Earth's surface.[33] Then the possibilities of the survival of life in extreme conditions is discussed, also in the Martian environment. The search for organic compounds on Mars and for metabolism proved unsuccessful, but even this negative result may help us to understand better the history of life development and evolution on the Earth.

Dr. Wołczek considered life as a global phenomenon, namely, the occurrence of life and rise of intelligent beings were stages of evolution of cosmic matter.[34] The terrestrial living system is based on carbon and water. Life might originate after passing by the Earth through many specific stages during very long lasting processes and very specific conditions: presence of a primitive reducing atmosphere, evolution of photosynthesizing organisms and an atmosphere containing rising quantities of oxygen, occurrence of continental drift, appearance of magnetodynamic shock waves and ozonosphere, magnetic field reversal and existence of various cosmic interactions. These conditions and facts exerted a deep influence on the course of this process. Despite essential links with the whole, man distinguishes himself fundamentally from all other living organisms by his exceptional evolutionary abilities. Due to the development of life and of intelligent beings the Earth has gained a special position in the Solar System, but most probably it is not an exception in the whole Universe. The quality of planets orbiting around other stars, where living organisms and even intelligent beings may have appeared, is not insignificant. The conquest of space has opened to mankind new and maybe exceptionally promising perspectives of further development.

Dr. Wołczek defined the properties of living organisms:[35]

1. Conservation of the individuality and self-limitation,
2. Exchange of matter, energy and information with the environment and their optimization,
3. Reproduction and transfer of the genetic information,
4. Evolution.

We do not know the nature of life, but probably it belongs to one of the fundamental properties of matter. It appears in suitable conditions in a similar way as the organic compounds.

The left-hand chirality of the molecules essential for the existence and evolution of living organisms is one of their fundamental features.[36] According to the opinion of the author the discrimination in favor of the left-hand chirality of the biogenic organic compounds reflects the deviation from symmetry (left-right hand symmetry) typical also of the non-living matter. It is a fundamental phenomenon on

a microscopic scale (parity non-conservation) and macroscopic scale (lack of antimatter in the Universe).

Dr. Wołczek discussed the idea of Svante Arrhenius and--in modern version--that of Crick and Orgel on the extraterrestrial origin of life on the Earth.[37] Biogenic molecules have particular chirality, similar molecules of abiogenic origin have equal amounts of left- and right-handed molecules, as the molecules found in the meteorites.

It is almost certain that only in conditions prevailing on the Earth could life persist and develop until it achieved the highest evolutionary stages.[38] According to present knowledge, the existence of foreign planetary systems seems very probable. Recent computer simulation indicated that only on some planets of stars comprised of a narrow range of stellar spectral classes could life evolve. The rise of intelligent beings could happen only in some biospheres. The possible scarcity of such beings and of their scientific and technical civilizations is understandable in the light of new information given in his paper.[38]

The time of duration of separate stages of planetophysical evolution of the Earth was determined by its mass, its position in the Solar System (the Sun's gravitational field) and the existence of a near-by situated relatively large Moon (its gravitation field and tide effects). Therefore it is possible that the change of one or several of these parameters might cause an adequate shortening or extension of the Earth's individual evolutionary stages deeply influencing the rise and evolution of the biosphere. Conclusion: In the Solar System only the Earth--most favorably situated in a very narrow ecosphere of this system--is a planet on which intelligent life could rise and develop.[37]

The paper Dr. Wołczek presented in Tokyo (1980) during the IAF Congress dealt with the influence of extraterrestrial environments on the possibility of CETI (Communication with Extraterrestrial Intelligence).[39] The author was looking for the influence of the cosmogonical and astrophysical factors on the course of the biological evolution of the Earth-like planets. On these planets should develop the four principal dynamic systems: internal or global (circulation of matter inside of the planet, tectonic and volcanic activity), atmospheric, magnetospheric, and biospheric. These systems could evolve on planets around stars of late F and G types, and some stars of K and M types. As a rule, terrestrial planets seem to appear in the region near the central star at a distance from a few tenths to a few AU. Their masses inferred from the example of the Solar System and from modeling vary from about 0.1 to 5 masses of the Earth, gravity force near 1 g, where g means the gravitational acceleration on the planet's surface, magnetic field screening the atmosphere against charged particles, and the moon determining the proper size and shape of the magnetosphere. All the above factors determine the possibility of the origin and proper evolution of higher organisms. Taking into account these factors one can elaborate the mathematical models of the development of life on the Earth to determine the probabilities of the particular parts of evolution of life on Earth.

The problem of barriers in CETI-SETI (where SETI means Search for Extraterrestrial Intelligence) was discussed in the paper.[40] Human interstellar flight

should be realized at very large distances in space and time with relativistic velocities. The distances and velocities are also the barriers, as well as the interaction with the interstellar environment: plasma and dust. Nobody knows the influence of relativistic flight on the human body. There are also the barriers connected with very high costs of CETI, lack of interest, fears of possible dangers caused by mutual contact, or even barriers in mutual understanding.

In this last paper Dr. Wołczek analyzed cosmic influences on the biological evolution and on SETI.[41] He defined the cosmic factors influencing the development of the biosphere and promoting evolution: variation of the radiation flux, both electromagnetic and corpuscular, of the Sun or a particular star, the fall of asteroidal and cometary bodies on the planetary surface, explosion of nearby supernovae, gamma flashes from the galactic nucleus, penetration of the planetary system by clouds of interstellar matter (dust), capture of a moon by the planet and very intensive tide effects.

Sometimes it happens that not one but two or even more of the above factors interact at the same time, changing deeply the course of evolution. Probably strong cosmic factors repeatedly influenced living organisms and their evolutionary path, choosing optimal solutions. Planetary factors act slowly, cosmic factors-rapidly--changing the planetary environment irreversibly. Mankind on the Earth is relatively young. Man has existed probably about four million years. *Homo sapiens* appeared just 110-100 thousand years ago. His civilization exists merely several thousand years. Therefore mankind never experienced the severe stroke of a cosmic factor. Dr. Wołczek thought cosmic factors may stimulate the quest for alien civilization and facilitate our SETI. A highly developed civilization exposed relatively frequently to the dangers of strong cosmic influences may develop protective measures enabling not only survival but also a quick recovery followed by further development.

LIST OF SCIENTIFIC PAPERS OF DR. OLGIERD WOŁCZEK

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