NIKOLAI NIKOLAEVICH BOGOLIUBOV – GREAT SCIENTIST AND HUMANIST OF THE XX-TH CENTURY

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August 21, 2009 marked the hundredth anniversary of Nikolai Nikolaevich Bogoliubov, World Science Classic. Bogoliubov's name entered forever the history of civilization. He was a Scientist of encyclopedic dimensions, one of the Creators of modern theoretical and mathematical physics, Founder of a constellation of scientific schools and of the widely known journal of Theoretical and Mathematical Physics. The logotype М∩Φ introduced by him, in Cyrillic, became the brand of a series of International Congresses on Mathematical Physics. (The last, XVI Congress of this series, was held in Prague, 2009, 3–8 August).

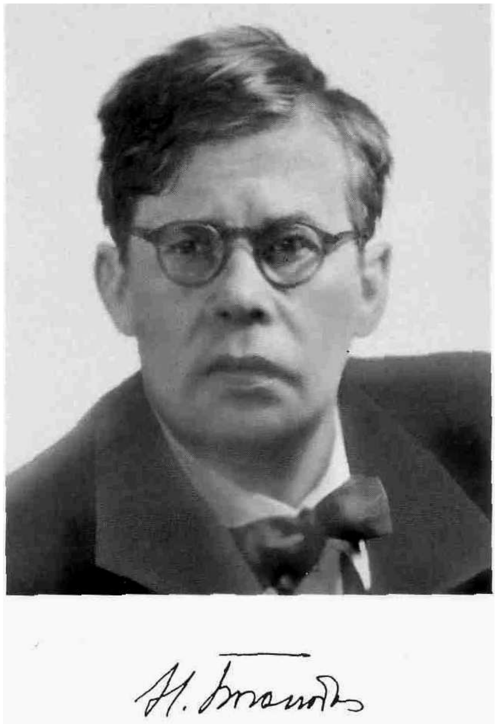
The present paper is a short review of N.N. Bogoliubov's life in science. His original papers, quoted in this review, can be found in [1]. For a colorful biography of the Master, we refer to Ref. [2].

Il libro della natura *é* scritto in lingua matematica.
Galileo Galilei

1. The Master

Bogoliubov was born in Nizhnii Novgorod to a highly educated family, giving the world three academicians. His father, Nikolai Mikhailovich Bogoliubov, was a prominent priest, philosopher and theologian, possessing encyclopedic knowledge – both in natural sciences and the humanities. The father played a decisive role in the early development of mathematical abilities of his son.

Already during his life, a myth (also connected with N. Wiener) existed, according to which a team of mathematicians, mechanics, and theoretical physicists worked, alias "N.N. Bogoliubov", similar to the known Bourbaki group.



Really, it is difficult to conceive how could one man create so many outstanding works in such different scientific branches. The proper word marking a scientist of such dimensions is *genius*. The organic cohesion of mathematics, mechanics, and physics, inherent in Bogoliubov, places his name near the greatest thinkers of the past – Newton, Euler, and Poincaré.

Bogoliubov's range among XX-th century scientists was established long ago. It was generally accepted that his research stimulated the creation of the unique character of the modern theoretical and mathematical physics, unifying the power of the mathematical logic with the profundity of the physical intuition.

2. Mathematical Genius

Bogoliubov's carrier begun in Kiev under the guidance of Academician N.M. Krylov. At the age of 15, Nikolai produced his first mathematical work. One of his important early papers was dedicated to a new direct method of variation calculus for nonregular functionals, and it contained a number of original solutions to the ideas of the Italian mathematician L. Tonelli. By Tonelli's presentation, this paper was awarded the Bologna Academy of Science's prize in 1930, and the author was consecrated into Doctor of Mathematics *honoris causa.*

This, initial period of Bogoliubov's scientific carrier, was dedicated to theoretical and applied mathematical problems. For example, he suggested a new construction of the theory of almost periodic functions. During this period, Bogoliubov and Krylov (1937) presented the first proof of the famous theorem of the existence of the *invariant measure* in dynamical systems.

After World War II, Bogoliubov's remarkable papers in modern mathematics appeared, by building the apparatus to solve new problems in theoretical physics. Note that proving theorems was never his mathematical hobby, instead he did so always *ad hoc.* He contributed to the solution of the most difficult mathematical problems of quantum field theory, thus changed the traditional view of the connection between mathematics and physics.

Such is the "edge of the wedge" theorem (Seattle, 1956) formulated and proved by him, as well as its generalizations and corollaries derived by his disciples and followers. It became a basic part of mathematics, opening a new successful part of the theory of analytic functions. The paper "On the self-similar asymptotics in quantum field theory" (1972, with V.S. Vladimirov, A.N. Tavkhelidze) initiated a new line of research in mathematics – the multidimensional Tauberian theory of generalized functions.

The R-operation suggested by Bogoliubov to remove ultraviolet divergences from Feynman diagrams and the theorem proved together with O.S. Parasiuk (1955) is among the most important contributions of Bogoliubov to quantum field theory. It has solved the crucial problem of the very existence of quantum field theory.

3. Nonlinear Mechanics as a New Branch in Science and Technology

Since 1932, Bogoliubov, in collaboration with Krylov, began developing an entirely new branch of mathematical physics, they called "nonlinear mechanics". These studies were carried out in two directions: developing a new asymptotic integration techniques of nonlinear equations of motion in oscillatory systems and laying a foundation for these methods based on measure theory.

Krylov and Bogoliubov extended the tools of perturbation theory to more general nonconservative systems, and they created new and well established asymptotic methods of nonlinear mechanics. Unlike the popular van der Pol's method, the corresponding solutions could be obtained not only in the first but in higher approximations as well. These methods became very useful in the studies of both periodic and quasiperiodic oscillatory processes.

Applying the Lyapunov–Poincaré and the Poincaré–Denjoy theory of trajectories on the torus, they studied the nature of an exact stationary solution near the approximate solution for a small parameter value and established the existence and stability theorems for quasiperiodic solutions.

Furthermore, the development of efficient methods of asymptotic integration for a wide class of nonlinear equations culminated, due to Bogoliubov and Krylov, in fundamental results. Bogoliubov also created new mathematical tools to study the behavior of general nonconservative systems with small parameter. The fundamental averaging principle was formulated and developed by Bogoliubov in the context of standard form equations (1945) and published in the monograph "Asymptotic Methods in the Theory of Nonlinear Oscillations" (in collaboration with Yu.A. Mitropol'skii, 1955).

In 1945, Bogoliubov also proved the fundamental existence theorem on main properties of a single-parametric integral manifold for a system of nonlinear differential equations in the standard form. He investigated periodic and quasiperiodic solutions on a one-dimensional manifold – the essence of a new method in nonlinear mechanics – the "method of integral manifolds".

In 1963, Bogoliubov has put forward a new idea on the application of the accelerated convergence techniques to nonlinear mechanics. In establishing this theory, Bogoliubov combined the method of integral manifolds with the iteration method by A.N. Kolmogorov and V.I. Arnold. This combined method gave rise to yet another method of accelerated convergence in nonlinear mechanics.

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4. Towards the Unified Description of the Nature

The above-mentioned achievements alone could be sufficient to immortalize Bogoliubov's name in the history of science. Yet, these investigations were merely a starting point for his further activity. As Bogoliubov wrote, "these methods appeared to be so flexible that it became possible to extend them later on beyond the scope of nonlinear mechanics *per se* and to use in completely other fields – in statistical physics, theory of kinetic equations, quantum field theory, *etc.*".

In the late 1930s, relying on the established mathematical foundation, Bogoliubov set to realize his approach to the description of the Nature. Later on, that approach largely contributed to the birth of the modern theoretical and mathematical physics. One of his first universal ideas was the concept of maximal conceptual proximity of the description of the Nature at classical and quantum levels.

This idea was first implemented by him in collaboration with Krylov in the comprehensive paper "On Fokker–Planck equations, application to classical and quantum mechanics" (1939). This paper contained a research program that basically predetermined the future scientific work of Bogoliubov and his disciples in statistical mechanics and quantum theory.

Its global aim is to open the way for the revision of the basic principles of the theory of stochastic systems interpreted in the broad sense of the word. In authors' opinion, the main attention in this theory should be paid to the description of weak, random effects on the considered relatively small object induced by the environment as a system with an infinite number of degrees of freedom. According to Bogoliubov and Krylov, even though the random effects are of both thermal and quantum types, it is most important that the results of these effects, as was earlier suggested by Einstein, can be described uniformly.

Bogoliubov's next major work was the monograph "On Some Statistical Methods in Mathematical Physics" (1945) which was, in essence, a direct continuation of the 1939 paper. Of extreme importance in the evolution of statistical physics was the result produced by Bogoliubov in Chapter IV of the 1945 book, where he considered a model example which allowed a detailed study of the emergence of an irreversible macroscopic process when an object approaches the state of thermal equilibrium.

By analyzing the problem of thermostat modeling, Bogoliubov was the first who noticed that the model traditionally used in quantum statistical mechanics is a classical one. As a result of this study, it was shown for the first time strictly that, on a long-time scale, the probability distribution for the coordinate and momentum of the considered object also came close to the Gibbs equilibrium canonical distribution with the thermostat temperature. In other words, the characteristics of the object that were dynamical at the beginning of the process become random quantities due to the infinite number of "contacts" with the thermostat walls.

5. Bogoliubov's Universal Ideas and Methods

Let us start from a number of Bogoliubov's universal ideas and methods that penetrate all his papers in statistical mechanics and quantum theory.

The first of these ideas is Bogoliubov's proposal to consider the problems of many-body quantum theory and quantum field theory on the same footing. He associated the similarity of these problems with the fact that, in both theories (owing to the pivotal role of the thermostat and vacuum, respectively), one has to deal with systems of infinite number of degrees of freedom. To realize this approach, Bogoliubov consistently used the second quantization method. A brief version of this method was published in the monograph "Lectures on Quantum Statistics" in 1949.

Prior to Bogoliubov's works, the second quantization method was thought to be a sophisticated technical trick. He succeeded in uncovering the deep physical meaning of this method, and giving the notion of "quasiparticle" its modern status. Moreover, he began to consistently apply this method not only to wave functions but also to dynamic variables, which allowed him to establish its deep relation to his method of statistical operators of groups of molecules. Finally, for the first time in the world literature, Bogoliubov showed the way of formulating a classical analog of the second quantization method. In particular, he used this method to derive microscopic solutions to the Vlasov and Boltzmann–Enskog kinetic equations.

Another universal idea put forward in his 1946 report, concerns a specific canonical transformation, since then called the Bogoliubov (u, v)-transformation. This transformation itself forms the basis of his microscopic theory of superfluidity of Bose and Fermi systems. However, the physical importance of this seemingly pure mathematical method is much deeper.

Quite a new situation appears in systems with an infinite number of degrees of freedom. Remaining canonical, the transformation of the same form leads to a unitary-nonequivalent representation of commutation relations.

In this case, qualitatively different "vacua" correspond to initial particles and quasiparticles resulting from the (u, v)-transformation. In other words, in this type of systems, one can observe a degeneration of the ground state manifested in many problems, both in the quantum theory of condensed matter and quantum field theory, and even in models of the early Universe.

The next step in the development of the integral approach to the solution of classical and quantum problems was made by Bogoliubov in April 1954 when he presented the important report: "Equations with variational derivatives in problems of statistical physics and quantum field theory".

In that report, he proposed a presumptive view of the method of equations in variational derivatives, closely related to the second quantization method. Due to this interconnection, it proved to be effective both in many-body quantum theory and in quantum field theory. The author was emphasizing that the "efficiency of the method is related to the presence of an infinitely large group of particles (either real or virtual) rather than to dynamical systems being quantized or classical".

Presently, the range of applicability of this universal idea of Bogoliubov is even wider due to the development of the versions of quantum field theory at finite temperatures, in which the vacuum and the thermostat are now supposed to be an integral thermofield vacuum. In fact, in this case, the quantum model of the thermostat introduced by Bogoliubov in 1978 is used.

6. Three Great Physics Theories

Among many outstanding scientific results in theoretical and mathematical physics, the following three great physics theories are unique.

Bogoliubov's kinetic theory of matter

Bogoliubov's monograph "Problems of Dynamical Theory in Statistical Physics" (1946) is recognized to be a classical work in the world scientific literature. The book, in which, typically of Bogoliubov, formal mathematics is deeply and intrinsically connected with intuitive physics, gained world-wide recognition. The book enjoyed multiple editions and translations into many languages. It largely predetermined the evolution of nonequilibrium and equilibrium statistical mechanics in the second half of the 20th century.

By this monograph, Bogoliubov undoubtedly marked, after Boltzmann and Gibbs, a new era in statistical physics. It suggested universal ideas of the weakening of correlations, the hierarchy of relaxation times, the abridged description of dynamical systems, the assigning of a clear physical meaning to the thermodynamical limiting transition. Finally, the famous chain of Bogoliubov equations (BBGKY-hierarchy) was derived, and the Bogoliubov–Balescu–Lenard collision integral for charged particle systems was introduced.

In his 1946 book, from the very beginning, Bogoliubov noted the fundamental contradiction inherent in the method of obtaining the kinetic equation by Boltzmann. The elimination of this contradiction became a major objective that Bogoliubov was guided by in both the 1946 monograph and further studies.

Following this way, he was the first to make common the equivalence of the description of classical mechanics problems using Hamilton's equations and the Liouville equation. In doing so, it was shown that the use of the Liouville equation does not distort the deterministic character of the system if the stochastic action of the environment is absent.

The account for this action radically changes the pattern and makes it one of the main physical features of Bogoliubov's kinetic theory. Induced by this action (due to the weakening of a correlation between their dynamical states), the objects of the system move, for large time intervals, practically without collisions with each other. This means that, in the asymptotic limit, the description of the original system of interacting particles reduces to the description of the system of "free quasiparticles".

One should also stress the physical differences between the kinetic equations in Boltzmann's and Bogoliubov's theories. In Boltzmann's theory, the hypothesis of molecular chaos is introduced *a priori*, which leads to a complete neglect of the correlations between the dynamical states of molecules. In addition, it is assumed that the individual motions of molecules and the stochastic process of binary collisions do not interfere with each other. Furthermore, the universal idea of the essential role of pair correlations underlies Bogoliubov's theory.

Bogoliubov returned to a further elaboration of the fundamentals of the kinetic theory in the 1970s. The paper "Microscopic solutions of the Bolzmann–Enskog equation in the kinetic theory of hard spheres" (1975) is a direct continuation of the famous 1946 monograph. The article deals with the important question of the relation between the dynamic and kinetic properties of the system. It was aimed at showing that the Boltzmann–Enskog kinetic equation has microscopic solutions corresponding to the exact motion of particles. Thereby, Bogoliubov's statement that elastic collisions alone, without the stochastic action of the environment, are not able to result in the stochastization of the system as a whole, was fully confirmed.

Bogoliubov's quantum theory of condensed matter

Since autumn 1946, Bogoliubov started the realizatioin of his universal approach to the description of Nature at both micro- and macro-levels. His report "On the theory of superfluidity" passed into history forever. This unique paper, reissued many times in many languages, is among the most frequently cited theoretical studies of the 20th century. Below, we focus on its physical ideas.

Let us recall the set of Bogoliubov's universal ideas initiated by the famous report of 1946. First of all, one should mention the ideas of quasiaverages and spontaneous symmetry breaking. First expressed in connection with the problem of ^{4}He superfluidity, both of these ideas were further developed by Bogoliubov. He applied them to various problems of statistical mechanics, including the theories of superconductivity, ferromagnetism, crystalline long-range order, *etc.*, as well as to describing nuclear matter and properties of massive nuclei. Bogoliubov highly valued these ideas and devoted extensive publications to them. Two of his talks dedicated to these results, in Utrecht (1960) and Hamburg (1973), were considered by him to be most important.

Judging by the title of Bogoliubov's report "On some problems of the theory of superconductivity" (1960), one could get the impression that this paper is devoted to a very special problem. However, it advanced a general physical idea. As noted by the author, it was for the first time that he clearly formulated the method of quasiaverages, though intuitively he used it since 1946.

In this connection, Bogoliubov focused his attention on the notion of degeneracy of a thermal equilibrium state. He showed that the naive idea of any state being nondegenerate was invalid, in fact. In the Nature, we come across thermal equilibrium states that are degenerate in some group of symmetries, usually hidden when using ordinary Gibbs averages.

According to Bogoliubov, for the derivation of an adequate description, one should first remove degeneracy, thus violating the invariance under transformations from the corresponding group of symmetries. Hence, in order "to use any form of perturbation theory for the study of a degenerate state of statistical equilibrium, one should first remove a degeneracy or, which is the same, use not ordinary averages obeying all selection rules but quasiaverages which do not obey some of them".

As Bogoliubov said during the receipt of the A.P. Karpinsky Prize (1981), "in the paper on quasiaverages, a fundamental theorem was also proved, according to which a long-range interaction always begins in a quantum system under spontaneous symmetry breaking. In other words, there appear massless excitations, quanta of types of photons or phonons... It was found out later on that if the theory of the so-called gauge fields is unified with the theory of spontaneous symmetry breaking, a set of a massless Goldstone boson and a massless gauge boson is equivalent to a massive gauge boson". It is well known that this original idea of Bogoliubov was further developed by Higgs, who realized it in the fundamental theory of electroweak interaction.

The appearance of "anomalous averages" of Fermi bilinear operators, that do not conserve the number of particles in the theory of superconductivity, led Bogoliubov to a new universal result. He showed that the generalization of the method of self-consistent field in the many-body quantum theory made possible to account for the pair correlations. It was named the Hartree–Fock–Bogoliubov variational principle. In these papers, Bogoliubov proposed also the hypothesis of superfluidity of the nuclear matter that was proved by a lot of experiments.

Finally, the most impressive among all Bogoliubov's universal ideas, in our opinion, exhibiting its general physical nature, was also formulated for the first time in his report of 1946. It is the spontaneous symmetry breaking due to the degeneracy of the ground state. This idea was thoroughly characterized by the author in his talk "On spontaneous symmetry breaking in statistical mechanics" (1973) delivered in Hamburg at the ceremony of awarding him the Planck gold medal.

After the creation, in 1957–1958, of Bogoliubov's superconductivity theory, the idea of spontaneous symmetry breaking went beyond the scope of statistical mechanics and came into use in many fields of physics. Especially, it came into a wide use in the description of the early stages of the evolution of the Universe. Later on, this idea together with the Bogoliubov's (u, v)-transformation was applied to the quantum theory of gauge fields, called the Higgs mechanism, which is now an important part of the Standard Model of elementary particles.

The importance of this Bogoliubov's idea is even greater. It touches upon the problem of the relation between the properties of the Hamiltonian entering the equations and the properties of system's states. Spontaneous symmetry breaking is the most illustrative example of this fact. At first, this phenomenon seemed to be merely an accident (anomaly). Nowadays, the situation has changed radically. In particular, the observation of various artificial Bose–Einstein condensates clearly shows the universality of the 1946 Bogoliubov theory for weakly nonideal Bose gases. This idea is simultaneously extended to other branches of physics. Obviously, it is high time to explain "spontaneous symmetry generation" under some exceptional conditions rather than spontaneous symmetry breaking.

It is appropriate here to give a global estimate of the 1946 Bogoliubov theory. For many years, it was considered merely as an auxiliary mathematical justification of Landau's theory of superfluidity. In fact, Bogoliubov in his theory made a principally new step – he predicted, for the first time, the existence of a new state of condensed matter in the Nature – nearly perfect fluids including the Bose–Einstein condensates (BECs) in nonideal gases of particles or quasiparticles. The number of newly discovered BECs in condensed matter, including excitons, magnons, *etc.* rapidly increases. Moreover, speculations on a new state of matter (quark-gluon plasma) created in high-energy heavy-ion collisions exist. Soon this may become an indispensable element in other branches of physics as well.

On the other hand, superfluidity and superconductivity are merely manifestations of the known properties of the new state of matter. During the past ten years, three Nobel prizes were assigned to the authors of theoretical works on these problems, as well as to experimentalists for the discovery of the BEC in dilute gases of alkali metals and the studies of their properties. Strange enough, the origin of all these discoveries, Bogoliubov's seminal theory of 1946 was never mentioned in the press-releases of the Nobel committee. More important for the science is the foundation of a particular discovery. Bogoliubov's name is firmly connected to the idea of the new condensed state of matter, and nobody will be able to change this story.

Bogoliubov's axiomatic quantum field theory

The next step in the development of an integral approach to the solution of classical and quantum problems was made by Bogoliubov in April 1954, when he presented three important reports within only several days: "Equations with variational derivatives in problems of statistical physics and quantum field theory", "On the representation of the Green–Schwinger functions in terms of functional integrals", and "Causality condition in quantum field theory".

In fact, these reports are parts of the unique work summing up Bogoliubov's decennial meditation and studies of problems that are common for statistical physics and quantum field theory. They formed the basis of the famous monographs "Problems of the Theory of Dispersion Relations" (with B.V. Medvedev and M.K. Polivanov, 1956), "Introduction to the Theory of Quantized Fields" (with D.V. Shirkov, 1957), "Introduction to Axiomatic Quantum Field Theory" (with A.A. Logunov and I.T. Todorov, 1969), "Some Aspects of Polaron Theory" (1981) and "Introduction to Quantum Statistical Mechanics" (1982) (both with N.N. Bogoliubov, jr.)

It is well established that it was the unification of the ideas of the reports that led Bogoliubov to the formulation of a system of axioms that allowed him to construct the relativistic quantum field theory based on general principles of covariance, unitarity, and microcausality without the direct use of the Hamilton formalism.

Moreover, his most general version of axiomatics preceded a much narrower axiomatic schemes proposed by Lehmann, Symanzik, and Zimmermann and Wightman, respectively. The modern Bogoliubov formulation of the system of axioms and its inherent possibilities for the consideration of a wider class of local models of quantum field theory were revealed by Bogoliubov's disciples and followers in their works. The main results in this field were later accumulated in the fundamental monograph "General Principles of Quantum Field Theory" written by Bogoliubov with A.A. Logunov, A.I. Oksak, and I.T. Todorov (1987).

Furthermore, within his version of axiomatics, Bogoliubov was the first to prove dispersion relations for the pion-nucleon scattering. The initial postulates and the results he obtained in this field were presented by Bogoliubov and Vladimirov in their contributions "On some mathematical problems of quantum field theory" to the International Congress of Mathematicians (Edinburgh, 1958), subject of numerous discussions.

The importance of these results for theoretical physics was also admitted by outstanding researchers. Serious interest in these investigations is demonstrated by the fact that, after the International Congress on Theoretical Physics (Seattle, 1956), where Bogoliubov reported, for the first time, on this subject, the contents of the future monograph was twice published in English and was widely covered abroad. Shortly thereafter, Bogoliubov showed the versatility of the method of dispersion relations in both quantum field theory ("The method of dispersion relations and perturbation theory" (1959, with A.A. Logunov and D.V. Shirkov) and almost simultaneously in statistical physics ("Retarded and advanced Green functions in statistical physics" (1959, with S.V. Tyablikov). These two papers became very popular and have many applications in further studies.

Among Bogoliubov's encyclopedic results which formed a whole line of investigations in quantum field theory, it is worth noting, undoubtedly, the discovery of renormalization group theory as an exact property of a renormalized quantum-field solution to Green functions. It culminated in the construction (1955, with A.A. Logunov and D.V. Shirkov) of the renormalization group method (RGM) with numerous applications in many fields of theoretical and mathematical physics.

The most important point of these works was the idea of invariant electron charge and a more general notion of invariant (running) coupling constant. The latter was used in the concept of asymptotic freedom that contributed to the advances of the non-Abelian gauge field theory and to the convergence of numerical values for three invariant coupling functions typical of the theories of "grand unification" of interactions.

Two ideas of Bogoliubov are among the most important achievements of the elementary particles theory, namely the existence of colored quarks and the model of quasiindependent quarks. Bogoliubov (1965, in collaboration with B.V. Struminsky and A.N. Tavkhelidze) were the first who suggested to introduce a new quantum number! Later on, it was called color. Their model of quasiindependent quarks was used as the concept of asymptotic freedom that led to the construction of quantum chromodynamics and was applied to the theories of "grand unification" of all interactions.

7. All-Time Man

To conclude, we cite a fragment from Bogoliubov's plenary report "Mathematical problems of quantum field theory and quantum statistics" at the 1-st International Conference on Theoretical and Mathematical Physics (1972, Moscow): "In the last 20–25 years, a new field of research emerged – the modern theoretical and mathematical physics as an integral science occupying an intermediate position between theoretical physics and mathematics. This line of investigations is called into being, first of all, by new tasks of the quantum physics of systems with an infinite number of degrees of freedom, nonrelativistic and relativistic, and requires the involvement of modern powerful mathematical tools...". Since then, this point of view gained a wide recognition.

It was a noble mission of Bogoliubov to become one of the founders of this field of research – theoretical and mathematical physics as an integral science and thus to lay a landmark in the foundation of the universal thermal quantum field theory of the matter surrounding us. As time passes by, the field of applications of his ideas becomes even wider.

Although the recognition of the scientific achievements came to Nikolai Nikolaevich rather early, it is not yet complete. The majority of his fundamental ideas were ahead of the time they appeared, for which reason they did not receive the due understanding and appreciation. The publication of the 12-volume edition of his works in Russia (2005–2009) reveals a rich intellectual treasure, whose comprehension will be the task of the next generation of researchers.

Implementing the will of the teacher, his disciples, being specialists in specific fields of science, continue developing his universal ideas tending to integrity in the description of the Nature. In other words, these fields are fundamentally indivisible in the works of the Master, as they are in the Nature. Consequently, even a cursory acquaintance with Bogoliubov's fundamental ideas shows how rich his scientific heritage is and also the general way his disciples and followers should develop his ideas, in the spirit of Leibniz and Planck, in the future.

There are few names in the history of sciences that deserve to be qualified as Great. Good reasons should be for that. Primary is, or course, the scale of their scientific achievements. Next is the value of a relevant contribution to the universal culture.

Bogoliubov's performance as that of a scientist, whose main ideas become classical already during his life, confirm beyond any doubt the validity of his position among the leaders of the exact sciences of the XXth century. However, this is not the whole story of the great man. Everybody who knew Bogoliubov personally bears in his mind his sublime faith in the spirit and the intellect of the human beings.

All his life was a testimony of these qualities. He made no secret of his devotion to the Christian values (he was attending the Orthodox church, was actively promoting the reconstruction of temples, *etc.*), respecting other confessions at the same time, and was against any religion hostility. He was a profound connoisseur of literature, philosophy, ancient history, and history of religions, with special admiration for the Medieval philosophers, whose religious teaching was, for him, an expression of deep mathematical conception of the world.

As a theoretical physicist, participated in the Russian atomic project, he did his best to avoid the catastrophic consequences of the possession of the atomic power. He was active in the Pagwash peace movement and supported, with all his force, the radiobiological studies and their medical applications, in particular those in oncology. He was cut to the heart by the Chernobyl' disaster not only because it concerned Russia and Ukraine, two countries he considered his motherlands. Moreover, he was concerned about the threat to the whole mankind.

Bogoliubov was a humanist in the true sublime sense of this word. He was a man who, like the Renaissance Titans, unified the fundamental scientific and spiritual values in his creativity.

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1. Nikolai Nikolaevich Bogoliubov, *Collection of Scientific Works in Twelve Volumes*, Ed.-in-Chief A.D. Sukhanov (Nauka, Moscow, 2005–2009) (in Russian).
2. A.N. Bogoliubov, *N.N. Bogoliubov, Life and Scientific Work,* edited by V.G. Kadyshevsky (JINR, Dubna, 1996) (in Russian).

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МИКОЛА МИКОЛАЙОВИЧ БОГОЛЮБОВ – НАЙВИДАТНІШИЙ ВЧЕНИЙ І ГУМАНІСТ ХХ-ГО СТОЛІТТЯ

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Р е з ю м е

21 серпня 2009 року відзначалося століття від дня народження Миколи Миколайовича Боголюбова – класика світової науки. Ім'я Боголюбова назавжди увійшло в історію цивілізації. Він був вченим енциклопедичного масштабу, одним з творців сучасної теоретичної і математичної фізики, засновником сузір'я наукових шкіл, а також широко відомого журналу "Теоретична і математична фізика". Логотип Ф∩М, запропонований ним, став знаком серії міжнародних конгресів з математичної фізики (останній, XVI-й Конгрес цієї серії відбувся у Празі 3–8 серпня 2009 року).

Ця стаття є коротким оглядом основних наукових результатів М.М. Боголюбова. Оригінальні роботи М.М. Боголюбова, які згадуються в огляді, можна знайти в його збірці творів [1], а коротку біографію – в роботі [2].