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## *ACADEMICIAN VLADIMIR ALEKSANDROVICH FOCK*

(on his sixtieth birthday)


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ACADEMICIAN Vladimir Aleksandrovich Fock, one of our greatest theoretical physicists, completed his sixtieth year on December 22, 1958.

Fock's scientific work began in his student days (his first published work appeared in 1923) and continued without interruption and with inexhaustible energy until the present time. It has dealt with a wide range of problems, and here we can mention only the main directions of Fock's scientific achievements, those which are best known and have brought him world-wide renown.

His first interest was quantum mechanics and quantum field theory. His first work in this field,[1-4] some of which was carried out during his stay abroad in 1927, immediately made Fock well known as a theoretical physicist. Some papers were devoted to the basic principles of quantum theory. Fock's work on the many-electron problem in quantum mechanics[5-7] led to the formulation of the method of the self-consistent field with exchange, the so-called Hartree-Fock method, and to the discovery of other approximate methods for constructing wave-functions. This made it possible to calculate precisely the electronic shells of various atoms. A review of the basic results is given in reference 8.

Fock's book "Principles of Quantum Mechanics" appeared in 1932. It was the first Soviet book on quantum mechanics and contained much original work.

Fock's papers on quantum field theory, written from 1928 to 1937 and recently collected into a book,[9-14,15] were not only of fundamental importance for the development of quantum electrodynamics, but are also still useful today. The mathematical ideas and methods which Fock introduced in these

papers were applied and generalized in the development of quantum field theory in the last few years. One remarkable paper on the hydrogen atom[16] occupies a special position in this field. In it he established an unexpected connection between the so-called "accidental" degeneracy of the hydrogen levels and a four-dimensional rotational symmetry.

The second main direction in Fock's scientific work is the theory of gravitation. The starting point was a paper of 1939,[17] in which the equations of motion of extended masses with spherical symmetry were derived from Einstein's field equations. The final result was a book "Theory of Space, Time and Gravitation,"[18] which appeared in 1955 and excited much interest and lively discussions among physicists. The book included solutions of many important problems of gravitation theory, and in particular a very complete discussion of the motion of a system of bodies taking account of their rotation and internal structure. Fock also derived a number of general results which allowed him to survey the theory of gravitation as a whole.

Fock worked intensively during the war and postwar years in a third field, the theory of diffraction. The importance of this subject arose originally from the rapid development of modern radio technology. He studied the propagation of radio waves around the earth as a problem in diffraction. He also studied the diffraction of electromagnetic waves by large conducting bodies having dimensions and radii of curvature much greater than the wavelength. These investigations were distinguished by the novelty of the mathematical methods and by the generality of the results. They have set a standard for all modern work in the theory of diffraction.

The monograph "Diffraction of Radio Waves around the Surface of the Earth"[19] was awarded a Stalin Prize, first class. It gave a complete solution to the problem of the field of an elementary dipole on the surface of a spherical earth. Later the results were generalized to the case of elevated sources of radiation,[20] and detailed tables of the propagation of radio waves were computed under Fock's guidance.

Fock's work[21,22] on diffractive propagation in a non-uniform atmosphere, whose refractive index is a function of altitude, led him to an elegant solution of the difficult problem of the range of radio waves under conditions of anomalous propagation. In the course of this work he made a very exact study of the classical analog of the tunnel-effect, the leakage of waves through the boundary of an inversion layer.

In three papers[24-26] Fock calculated the diffractive field produced by a plane wave incident upon the surface of a conducting convex body. In another paper[27] he investigated the field at great distances from the body. He showed that the field arising from diffraction by a convex body can be expressed in terms of the same functions (defined by contour integrals) which he had introduced in his theory of wave propagation over a spherical earth. This opens the possibility of a solution of diffraction problems for large bodies of arbitrary shape.

Fock loves to find practical problems which lead him to investigations requiring original mathematical techniques and the development of new methods. In such cases he usually provides not only a solution in principle, but a reduction of the solution to practical formulae and tables. Many researches of this kind, devoted to quite diverse problems, reveal Fock in the role of a specialist in mathematical methods. One should also mention one paper[28] in which he found an elegant solution to the complicated problem of the skin-effect in a ring.

The best known of Fock's works in pure mathematics are papers[29,30] on the theory of integral equations with a kernel that depends only on the difference between the variables. This work has become a standard tool in theoretical physics and has led to exact solutions of many interesting problems.

Fock takes an active interest in all questions relating to the healthy development of Soviet physics. Sometimes, in the course of scientific research, scientific truth is in danger of being distorted, and sometimes scientists do not observe the normal ethical standards of scientific and creative work. In such cases, if the questions at issue concern him, he invariably speaks out and expresses his opinion with the same directness and exactitude with which he formulates the results of his scientific research. The honesty and the directness of the "Fockian" character are well known not only here but also among scientists abroad. This honesty is especially clear when he is concerned with philosophy or with the fundamental problems of modern physics. Fock reacts hotly against incorrect and unscientific papers, either in the theory of relativity or in quantum theory, when they occasionally appear in our journals, and he always defends modern physical theory. He considers this activity, in distinction to his purely scientific work, as a part of his public duty.

Fock is an alumnus of Leningrad University, in which his scientific and teaching career began in 1922. In Leningrad he continues his fundamental scientific work still. In Leningrad University he holds a chair and gives much time to the education of the young people. Many are the pupils of Fock's school who are working successfully in various branches of theoretical and mathematical physics.

Having a sociable character, Fock is an entertaining companion, widely read in the most diverse fields of human culture and knowledge. His partici-

pation at congresses, meetings and other scientific gatherings is always desired both here and abroad.

The editors of JETP, in the name of all Soviet physicists, heartily congratulate dear Vladimir Aleksandrovich Fock on his sixtieth birthday, and wish him health and many more years of fruitful activity.

Bibliography of V. A. Fock

[1] Schrödinger's Wave Mechanics. Z. Physik **38**, 242 (1926).

[2] An Invariant Form of the Wave Equation and the Equation of Motion of a Charged Particle. Z. Physik **39**, 226 (1926).

[3] The Relation Between the Schrödinger Equation and the Integrals of Quantum-Mechanical Equations of Motion. Z. Physik **49**, 323 (1928).

[4] Generalization and Solution of the Statistical Equation of Dirac. Z. Physik **49**, 339 (1928).

[5] An Approximate Method for Solving Quantum-Mechanical Many-Body Problems. Z. Physik **61**, 126 (1930).

[6] Self-Consistent Field with Exchange for Sodium. Z. Physik **62**, 795 (1930).

[7] Quantum Exchange Energy. Z. Physik **81**, 195 (1933); J. Exptl. Theoret. Phys. (U.S.S.R.) **4**, 1 (1934).

[8] The Many-Electron Problem in Quantum Mechanics and the Structure of the Atom. Anniversary Volumes Celebrating Thirty Years of the Great October Socialist Revolution, Vol. 1, Moscow-Leningrad, Academy of Sciences Press, 1947, p. 255.

[9] Configuration Space and Second Quantization. Z. Physik **75**, 622 (1932); **76**, 352 (1932).

[10] Dirac's Quantum Electrodynamics (With B. Podol'skii), Sow. Phys. **1**, 798 (1932).

[11] Quantization of Electromagnetic Waves and Interaction of Charges in Dirac's Theory (with B. Podol'skii), Sow. Phys. **1**, 801 (1932).

[12] Quantum Electrodynamics (with P. A. Dirac and B. Podol'skii), Sow. Phys. **2**, 468 (1932).

[13] Quantum Electrodynamics. Sow. Phys. **6**, 425 (1934).

[14] Proper Time in Classical and Quantum Field Theory. Izv. Akad. Nauk, SSSR, Ser. Fiz. **4-5**, 551 (1937); Sow. Phys. **12**, 404 (1937).

[15] Papers in Quantum Field Theory. Leningrad State University Press, 1957.

[16] The Theory of the Hydrogen Atom. Z. Physik **98**, 145 (1935).

[17] The Motion of Finite Masses in General Relativity. J. Exptl. Theoret. Phys. (U.S.S.R.) **9**, 375 (1939).

[18] Теория пространства, времени и тяготения (Theory of Space, Time and Gravitation) Moscow, GITTL, 1955.

[19] Дифракция радиоволн вокруг земной поверхности (Diffraction of Radio Waves around the Surface of the Earth) Moscow-Leningrad. Academy of Sciences Press, 1946.

[20] The Field of a Vertical and a Horizontal Dipole above the Surface of the Earth. J. Exptl. Theoret. Phys. (U.S.S.R.) **19**, 916 (1946).

[21] Propagation of a Plane wave around the Earth Taking Account of Diffraction and Refraction. Izv. Akad. Nauk, SSSR, Ser. Fiz. **12**, 81 (1948); Сб. Исследования по распространению радиоволн (Investigations on the Propagation of Radio Waves) Vol. 2, edited by B. A. Vvedenskii, Moscow-Leningrad, Academy of Sciences Press, 1948.

[22] Theory of Propagation of Radio Waves from an Elevated Source in an Inhomogeneous Atmosphere. Izv. Akad. Nauk, SSSR, Ser. Fiz. **14**, 70 (1951).

[23] Approximate Formula for the Distance of the Horizon with Anomalous Propagation. Радиотехника и электроника (Radio Engineering and Electronics) **1**, 560 (1956).

[24] Distribution of Current Induced by a Plane Wave on the Surface of a Conductor. J. Exptl. Theoret. Phys. (U.S.S.R.) **15**, 693 (1945).

[25] The Field of a Plane Wave Near the Surface of a Conducting Body. Izv. Akad. Nauk, SSSR, Ser. Fiz. **10**, 171 (1946).

[26] The Laws of Fresnel Reflection and Diffraction, Usp. Fiz. Nauk **36**, 308 (1948).

[27] Fresnel Diffraction by Convex Bodies. Usp. Fiz. Nauk **43**, 587 (1951).

[28] Skin Effect in a Ring. Sow. Phys. **1**, 215 (1932).

[29] A Class of Integral Equations. Math. Z. **21**, 161 (1924).

[30] Some Integral Equations of Mathematical Physics. Матем. сб. (Math. Collection) **14**, 3 (1944).

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