From the history of the Journal of the Russian Physicochemical Society/JETP (In observance of the centennial of the Russian Physical Journal)

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(for the Editorial Panel of JETP)

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Science differs from all other forms of human activity in that its history is actually written by its creators themselves. Each step, each success or failure is recorded (with less emphasis on the latter) in the pages of numerous scientific journals. In Russia, one such journal was the predecessor of the Journal of Experimental and Theoretical Physics (JETP)—the Journal of the Russian Physicochemical Society, which published its first physics papers one hundred years ago, in 1873. The first journal became the chronicle of the development of physics in our country, the path of which is therefore easily retraced as we leaf through its pages.

Since this article is devoted to the history of the development of JETP, it is inevitable that certain first-class papers of Russian scientists that were published in other journals or in books are not represented in it. Scientific papers published in the Journal of the Russian Physicochemical Society (JRPCS) (from 1873 through 1930) are examined in greatest detail. This is justified on the one hand by the fact that the contemporary reader is familiar with most later works and, on the other, by the fact that modern physics has flourished to the degree that even a brief listing of its attainments would exceed the scope of this article.

PHYSICS IN RUSSIA AT THE END OF THE NINETEENTH CENTURY

The Academy of Sciences was the chief center of Russian physics in the eighteenth and early nineteenth centuries. True, scientific bases were gradually taking form in other institutions, chiefly the universities, as far back as the beginning of the nineteenth century. However, the outstanding physicists of the day (V. V. Petrov, E. H. Lenz, B. S. Jacobi) were still at work in the Physics Division of the Academy of Sciencies. The chief historical reason for this was that, as compared with other institutions, the Physics Division was much more richly endowed with instruments, And the state of affairs at the colleges was described splendidly by A. N. Krylov in an address before a 1914 session of the Physics Division of the Russian Physicochemical Society (RPCS) devoted to the memory of I. I. Borgman (46A (1914):[1]

"Such was the usual state of affairs in the Electrical Engineering Section of the Physics Division of any college 40 years ago: in the middle of the room, occupying a bit less than half of its floorspace, there stands on glass legs a monstrosity with a glass wheel on a glass shaft; over it, a few ten-gallon Leyden jars; on a shelf in the corner, but as often as not on the window sill (which shakes less) a primitive galvanometer, then known as "a multiplicator with an astatic needle," a Jacobi agometer, a Daniel battery, a worn-out Morse telegraph apparatus, and an electric bell not for sounding the alarm, but for use as a physical instrument; that was it."

The lack of physical laboratories, a physics periodical, a single center toward which the physicists of Russia might gravitate, the disregard of scientific interests on the part of the country's ruling circles placed insurmountable obstacles before the development of original scientific creativity in Russia.

The idea that the physicists should be unified in a society or circle was voiced with increasing frequency by many scientists of that period. At first, small groups would form around one of the more active professors. At St. Petersburg, for example, physicists met at the apartment of the well-known pedagogue K. D. Kraevich, the author of a familiar physics schoolbook of the day that introduced several generations of scientists to its subject. In Moscow, a circle formed around A. G. Stoletov.

All of this was a consequence of an important historical period in the life of the country, which had begun with the abolition of serfdom in 1861—an event that opened the way to the rapid development of industrial capitalism in Russia. The eighteen-sixties prepared the soil and created the favorable conditions under which the genuine need for a Physical Society could make itself felt.

Characterizing the state of physics during that period, N. A. Gezekhus wrote in his "Historical Outline of a Decade of Activity in the Physical Society" (14A, 5, (1882)):

"It can be states without exaggeration that the history of the Physical Society has been, at the same time, the history of physics in Russia during the past 10 years. Since the establishment of the Physical Society, almost everything with a bearing on physics in Russia has been concentrated exclusively in it, finding one reflection or another and, in any event, leaving its imprint there. Most of the physical investigations of Russian scientists have, since that time, appeared in the Journal of the Physical Society; however, others that have been printed in the Notes (Zapiski) of the Academy, in foreign periodicals, or as separate books, have in our journal either a brief reference, comment, or mention, and attract the notice of the Physical Society in one way or another.

"The modest—to be charitable—physical literature that existed before the establishment of the Physical Society consisted of academic memoirs and occasional obscure dissertations for scientific degrees. However, conditions for scientific research in physics were so unfavorable that many professors limited their scientific activity to the two mandatory dissertations, and even these were, for the most part, written abroad in German universities. Physics in Russia was then in its rank infancy and totally stagnent. There were neither traditions, nor schools, nor student laboratory activities, without which it is difficult to develop a good experimentor, nor the facilities and necessary atmosphere, which take form only gradually and slowly, nor a learned journal, nor gatherings that might have made it possible to exchange ideas and stimulated activity; nor were any of these things remembered.....

"The abnormality of this state of affairs must, of course, have been recognized by many; indeed, attempts had been made long before this to form a society with the object of promoting the development of the physical sciences in Russia.

"Recognition of the need for and possibility of establishing a Physical Society was made even clearer by the example set by the success of the Natural History Society and the Chemical Society, which had been formed soon after the first congress of Russian natural historians. Finally, thanks to the efforts of F. F. Petrushevskiĭ, the charter of the Physical Society was approved on 11 March 1872. From that day, the center of gravity of physics in Russia has been shifting from the Academy of Sciences toward the Physical Society."

Petrushevskiĭ was unanimously elected President of the new Society.

Fedor Fomich Petrushevskiĭ (1828–1904) was then the chief protagonist of physics at St. Petersburg. One of the pioneers in experimental instruction in physics, he had organized the first student physics laboratory at Petersburg University in 1865 and written the "Course in Observational Physics" (1874), a university textbook used by a whole generation of Russian physicists.

Petrushevskiĭ himself was extremely modest in evaluating his part in the establishment of the Physical Society, stating that he had simply "decided, in accordance with the wishes of many other people, to take the initiative in founding a Physical Society" (12A, 22 (1880)). Petrushevskiĭ was permanent Chairman of the Physics Division and six times President of the RPCS.

By the end of 1872, the Society had 55 members, and their number had grown to 77 by the end of 1873. In addition to Petrushevskiĭ, the charter members of the Society were B. S. Jacobi, R. E. Lenz (the son of the famous physicist E. H. Lenz), A. V. Gadolin, V. V. Lermantov, N. N. Trytov, and K. D. Kraevich. According to the laws of that time, a scientific society, as a union of private individuals, was supposed to come officially under the jurisdiction of some government agency. The Physical Society was assigned to the St. Petersburg University.

D. I. Mendeleev took an active part in the activity of the Society from its very inception. On 12 October 1872, he himself made the first scientific report to the Society, a communication devoted to the certification of two meters and two kilograms against the standard measures of the Paris Conservatory of Arts and Crafts. The subject of this first communication to the brand-new Society, which was starting out on the path of precise experimental research, could obviously not have been more appropriate.

On the same day, 12 October 1872, the decision was taken to "enter into an arrangement with the Chemical Society under which physical articles would be printed in the journal of that Society." Thus, beginning in 1873, the Journal of the Russian Physical and Chemical Society (JRPCS) made its appearance, with editorial responsibility charged to the Society's business manager, D. K. Bobylev. He himself wrote the first article published in the journal, "On the Dissipation of Electricity in Gases." Working from the kinetic theory of gases, he showed that the dissipation of electricity in air by charged conductors decreases with decreasing pressure.

The physical and chemical parts of the journal were separated only a year later. Because of the increase in the bulk of the journal, the Physical Part was paginated separately and divided into two sections. The first section, which Bobylev edited, included the "Protocols of the P. S., articles by Members of the Society, which were read at its sessions, and papers by persons who, though not belonging to the Society, have submitted their papers for perusal and printing." The second section of the Physical Part, of which Petrushevskiĭ was editor, consisted of "abridgements of articles on physical subjects that are appearing in contemporary foreign publications" (6A, 1 (1874)).

The separate existence of Chemical and Physical Societies was not of long duration. At the 13 January 1876 session of the Physical Society, D. I. Mendeleev proposed that the Physical Society be combined with the Chemical Society, "for the purpose of holding joint public sessions in addition to the special meetings, so as to increase the strength and knowledge of both Societies, which are already united in publication of the journal, a common interest in many subjects, similarity of organization, and approximately equal membership and funds" (8A, 58 (1876)). The merger of the two societies took place on 10 January 1878, and from that date the journal came to be known as the "Journal of the Russian Physicochemical Society." As of February 1875, I. I. Borgman became editor of the physical part of the journal, since D. K. Bobylev, who had acted simultaneously as the Society's business manager, was no longer able to handle the increased volume of publications.

Immediate notice was taken of the advent of the new journal in Russia: for example, an 1874 session of the Society "gave its consent" to an exchange of publications with the Urals Society of Naturalists, which had submitted its Notes, and with the Tiflis Meterological Observatory. Permanent relations were established between the Physical Society and the Physical Society of Paris (which was organized a year later). Brief excerpts of papers read at its sessions were regularly printed in the JRPCS. In remarks made on 28 April 1881, editor Borgman reported that, in response to invitations that he had sent out in the name of the Physical Society to enter into exchanges of publications, the following scientific societies had expressed the desire to begin such exchanges: the Philosophical Society at Glasgow, the Physical Society at London, the Society of Spectroscopists at Rome, the Boston Academy of Sciences, the Royal Society of Edinburgh, and the Turin Academy of Sciences.

The rapid development of industry during the latter half of the nineteenth century, the machinery industry and the advent of aviation produced large numbers of papers of applied character with a bearing on the motion of bodies in a gravitational field, the statics and dynamics of systems of material points, solids, liquids, gases, etc. Let us first turn to the works of Dmitriĭ Konstantinovich Bobylev (1842–1918), the first editor of the Physics section of the JRPCS, who was in charge of instruction in theoretical mechanics at the Petersburg University and in the St. Petersburg Institute of Communications Engineers. The hydrodynamic problem of the pressure of a jet stream on the wall of a wedge in the stream bears the name of Bobylev. In 1881, he published his "Notes on the Pressure Exerted by a Stream of Unbounded Width on Two Flat Walls that Converge at an Arbitrary Angle" (13A, 63 (1881)). Working from Kirchhoff's solution of the problem of the pressure of a stream of liquid on a flat wall, Bobylev showed that this pressure is proportional to the first power of the angle of taper of the wedge when that angle is small. This fact, which had been established experimentally back at the end of the eighteenth century, had not been substantiated mathematically prior to Bobylev.

In 1884, the JRPCS carried an article by N. P. Petrov (1836–1920) "On the Friction of Well-Lubricated Solid Bodies and on the Principal Results of Experiments on the Internal and External Friction of Certain Lubricating Fluids" (16A, 14 (1884)). This paper, as Petrov himself noted, was prepared in response to inquiries from his contemporaries in industry. N. P. Petrov taught applied mechanics at the Engineering Academy and the Institute of Technology; by occupation, he was a railroadman. The external appearance of well-lubricated rubbing solids moved Petrov to suggest that the lubricating fluid separates these surfaces completely. Hence it followed at once that the friction in such cases must depend on the friction between the lubricating fluid and the solid body and on the friction within the lubricating film. Thus, Petrov carried this problem into the field of fluid mechanics. He not only showed that the available results were described nicely by the formula that he derived for the frictional force, but also eventually made the measurements that confirmed his conclusion. In 1886, Petrov's hydrodynamic theory of lubrication was generalized by N. E. Zhukovskiĭ to the case of friction between nonconcentric cylinders (18A, 209 (1886)).

At about the same time, Zhukovskiĭ solved the problem of the motion of a solid body enclosing masses of liquid (17A, 81 (1885)). He developed a general theory of the motion of the body and the liquid masses enclosed in it without consideration of friction (on the assumption that the flow of the liquid was potential). Here it was found that the internal motion of the liquid is fully defined by the rotation of the body and does not depend on its translational motion. For the case in which friction is present, Zhukovskiĭ derived a theorem of the limiting motion that a cavity of arbitrary shape acquires after the lapse of a long time interval. In this limiting motion, "one of the principal axes of inertia of the masses under consideration will occupy the direction of the principal initial angular momentum, and the entire system will rotate about it as a single immutable body at a constant angular velocity."

Nikolaĭ Egorovich Zhukovskiĭ (1847–1921) did a great deal of work toward development of the foundations of aerodynamics, and his works synthesized scientific and engineering problems brilliantly. His teaching activity was associated for the most part with the Moscow University, where, from 1886 on, he headed the Department of Applied Mathematics; at the same time, he was a Professor of Theoretical Mechanics at the Moscow Technical College (now the Moscow Bauman Higher Technical School). In a paper "On the Theory of Flight" (22A, 3 (1890)), Zhukovskiĭ investigated one of the most important problems of flight theory—the ancient problem of the fulcrum. Where does the thrust force acting on the center of gravity of the body come from when the body can develop only internal forces that are pairwise equal and opposite? Zhukovskiĭ's conclusion is forthright: "A body immersed in an incompressible fluid mass that is enclosed in a very large stationary tank and has no friction cannot develop a constant thrust force by means of internal forces. But if a certain vortical motion is developed by means of fluid friction, the pressure and friction forces of this motion against the infinitely distant walls of the tank will give a force equal and opposite to the thrust force."

The Physical Society engaged not only in scientific activity, but also in extensive educational works. Highly indicative in this respect was a public statement by Russian scientists on the enthusiasm of "enlightened" strata of society for spiritism, the obsession with which was cloaked under pseudoscientific theories. Mendeleev appeared at a session of the Physical Society on 6 May 1875. As a true scientist, he could not but be disturbed by the incipient spiritual disintegration of society. In his words: "It seems that the time is right for attending to the prevalence of interest in the so-called spiritualistic or mediumistic phenomena, both in domestic circles and on the part of certain scientists. Fascination with the turning of tables, communications by knocking with unseen beings, and experiments in which the weight of bodies is reduced and human figures are called up through the intermediary of mediums threatens us with a wave of mysticism capable of distracting many from their healthy view of things and strengthening superstition, through the notion that there are spirits who are supposed to have produced the above phenomena. To counter the spread of this baseless doctrine and the present fruitless interest in mediumistic phenomena, they should not be ignored, but should, in may opinion, be subjected to precise scrutiny..."

The society resolved to form a commission to look into mediumistic phenomena. Its basic conclusion: "Spiritistic phenomena arise from unconscious movement or unconscious deceit, and the spiritistic doctrine is superstition." Petrushevskiĭ also submitted his own statement: "I personally, having been a member of the commission, can say that it summoned a large portion of patience, taking a completely objective attitude toward what was shown it at the so-called mediumistic seances, and continues to hope that its moral toil will have been of service to someone."

The development of electrodynamics during the latter half of the nineteenth century was in fact advanced under the banner of Maxwell's ideas. It is not surprising that many studies of electricity and magnetism were also carried out in Russia.

Let us first dwell on the work of R. A. Kolli (1845–1891), a student of Stoletov who was a Professor at Kazan' University for 10 years from 1876 through 1886 and then worked in Moscow at the Agrucultural Academy, heading its meterological observatory.

In his "Treatise on Electricity and Magnetism," Maxwell stated that the acceleration of a conductor must, generally speaking, result in the appearance of electromotive forces in it. Maxwell himself did not observe these effects experimentally. In the paper "On the Existence of the Ponderoelectromagnetic Field" (13A, 259 (1881)), Kolli showed that these effects "doubtless" exist in electrolytes. He attempted to detect them in 1882 and believed that he had succeeded. But, as was shown by Stoletov in an outline of Kolli's works, the "extremely small quantity that was sought was nearly last among the errors of observation" (23A, 448 (1891)).

A theory of this phenomenon in electrolytes in which ultrasound propagates and gives rise to large accelerations was submitted by Debye only in 1933, and reliable experimental results awaited the 1950's and 1960's. As we know, Tolman and Stewart (1914) observed the inertial emf experimentally in metals.

Another significant contribution of Kolli pertains to methods of observing rapidly varying electrical oscillations. He built the first oscillograph (which he called an oscillometer) (23A, 1 (1891)). Using it, Kolli determined the ratio of the units of quantity of electricity in the electrostatic and electromagnetic systems. Kolli's oscillometer was an electromagnetic galvanometer. A light magnet in the form of a plate secured to the back of a mirror was placed in the magnetic field created by two coils. The mirror with the magnet was secured on a silk filament stretched vertically between two springs. Then an alternating current was passed through the coil windings, the magnet was subjected to an alternating torque and the mirror began to oscillate. The motion was scanned by means of a rotating wheel that was set up in front of the system housing and in which a small peripheral hole had been made to pass light. The flying spot was observed in a measuring microscope. The first application of the Kolli oscillograph was in study of oscillatory processes in the induction coil known as the "Ruhmkorff coil" (23A, 7 (1891)). As Kolli himself noted, "establishment of the electrical processes of the Ruhmkorff coil makes possible a more deliberate approach to its use, broadens the range of its applications, and makes it possible to find ways to its further improvement."

Nikolaĭ Aleksandrovich Gezekhus (1845—1918), professor of physics at the St. Petersburg Institute of Technology, played a major part in the activity of the Physical Society, serving as editor of JRPCS from 1911 through 1918. Gezekhus investigated the absorption of hydrogen by palladium and its alloys for a number of years, and then turned his attention to the elastic aftereffect. In 1883, he had begun to study the conductivity of selenium (15A, 123, 149, 201 (1883)), and this problem continued to occupy him until 1905 (37A, 221 (1905)). Gezekhus proposed the following theory for the photosensitivity of selenium (selenium is a semiconductor that acquires conductivity under illumination). Selenium can occur in several allotropic modifications. On heating, it makes a smooth transition from the amorphous to the crystalline and thence to the metallic state, which corresponds to a simpler structure. Selenium apparently contains free ions even in its metallic state. Under exposure to light, there is a transition from one state to another, and the number of free ions should increase; in the dark, this excess of ions is rebound. The formula for the current that Gezekhus derived on the basis of these considerations described the experimental results quite accurately.

The scientific authority of the Physical Society and its journal JRPCS increased very rapidly in Russia. We can appreciate this today perhaps even more keenly than their contemporaries. We refer to the minutes of the Society's session of 26 October 1882:

"P. P. van der Vliet, submitting an article on the theory of gases by one Mr. Tsiolkovskiĭ, a teacher at a district school in the town of Borovsk, Kaluga Province, reports that although the article itself presents nothing new and certain conclusions drawn in it are not quite accurate, it nevertheless reveals the author to be capable and conscientious in his work, since he received no formal education and is entirely self-taught; the sole source for the work submitted here consisted of certain elementary textbooks on mechanics, Professor Petrushevskiĭ's "Textbook of Observational Physics" and Professor Mendeleev's "Fundamentals of Chemistry." It is therefore desirable to promote the further self-education of the author. The society has resolved to sponsor Mr. Tsiolkovskiĭ before the Trustees of the St. Petersburg or Moscow District on behalf of his removal, if he so desires, to a town in which he can make use of scientific study aids."

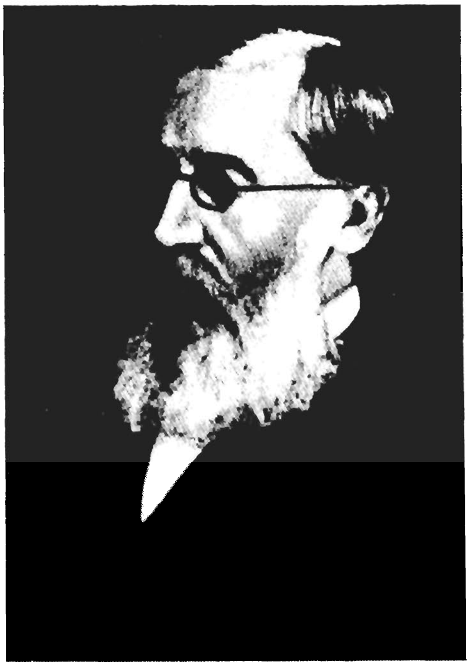
We encounter the name K. É. Tsiolkovskiĭ a few more times in the protocols of the Physical Society. His by-line appears on 14 March 1900 under the tital "On the Pressure of Air on Surfaces Placed in an Artificial Stream of Air." He had made all instruments himself; a box divided into channels equalized the flow from a blower. The experiments themselves were carried out with extreme care. Many of the conclusions agreed with results that had been obtained by noted physicists, ship designers and other scientists with the aid of extremely precise methods and instruments, although Tsiolkovskiĭ knew nothing of these experiments. In his summary, Petrushevskiĭ thanks Mr. Tsiolkovskiĭ in the name of the Division "for submitting his interesting investigation to the Physics Division" (32A, 131 (1900)).

A note from the office of the Physics Division appears in the journal in 1885:

"The Physics Division has organized an editorial bureau consisting of persons who manage the affairs of the division and given it the responsibility of intervening in editorial matters in certain cases. This measure was taken with the purpose, among others, of placing limits on the polemic that has recently taken on undesirable dimensions and tendencies in the physics division of our journal.... We shall mention here neither the name of the author nor his pronouncements, but in this matter the Bureau, proposing to begin discharging its responsibilities forthwith, considers it necessary to declare that it must look after the interests of the physics journal as a scientific organ that is not to be used to settle personal accounts between authors; the Brueau adds to the above that it is unable in such cases to enter into prolonged correspondence regarding articles submitted for its consideration." (This apparently concerns the polemic between Kraevich and Stoletov on the dependence between the vapor pressure and density of a gas in the rarefied state.)

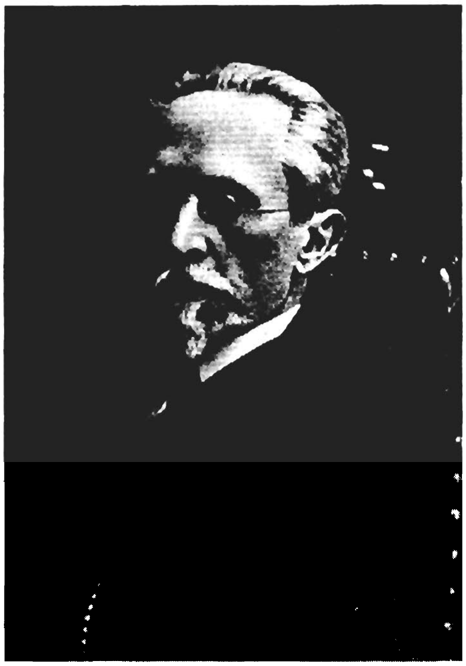
The first rules regarding the publication and editing of the Journal of the Physical Society were formulated at the same time:

"1) The editor will select from the papers submitted to him those which, in his opinion, are unquestionably suitable for printing. 2) Other articles will be examined by the Bureau, which will decide which of them should be printed: a) in full; b) in excerpt form; c) with changes agreed to by the authors; and d) which papers



Fedor Fomich Petrushevskiĭ

Chairman of the Physical Society from 1872 through 1904



Ivan Ivanovich Borgman

Editor of JRPCS from 1875 through 1902

Dmitriĭ Konstantinovich Bobylev

Editor of the Physics Section of JRPCS from 1872 through 1875

Nikolaĭ Aleksandrovich Bulgakov

Editor of JRPCS from 1903 through 1907

are totally unsuited for printing. This measure is proposed not as a means of lowering costs, since the review commission regards the expenditure for the journals as most productive, but because the journal should, in its opinion, carry only articles of exceptional scientific character."

A paper by A. G. Stoletov (1839–1896) on "Actinoelectrical Investigations" appeared in the journal in 1889 and won its author universal recognition. Thanks to the indefatigable scientific and scientific-administrative activity of A. G. Stoletov, Moscow University occupied the foremost position in Russian physics in the nineteenth century.

Stoletov showed that when ultraviolet light strikes a metal plate connected to the negative pole of a galvanic cell whose positive pole is connected to a metal screen placed parallel to the plate and separated from it by a certain layer of air (the light rays pass through this

Vladimir Konstantinovich Lebedinskii
Editor of JRPCS from 1907 through 1911

Nikolaĭ Nikolaevich Georgievskiĭ
Editor of JRPCS from 1919 through 1924

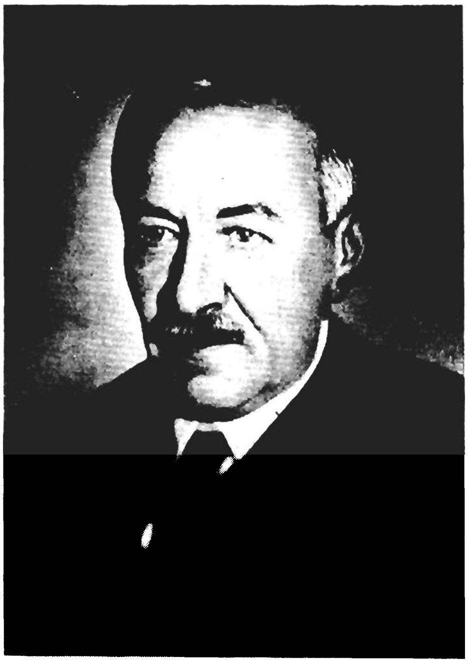
Nikolaĭ Aleksandrovich Gezekhus
Editor of JRPCS from 1911 through 1918

Abram Fedorovich Ioffe
Editor of JRPCS from 1924 through 1930 and of JETP from 1931 through 1939

screen), a current flows in the circuit and vanishes when the illumination of the plate ceases or when a medium that absorbs ultraviolet rays is placed in their path. Here we have Stoletov expounding on his results (21A, 159 (1889)):

"1) The rays of a voltaic arc, on striking the surface of a negatively charged body, carry charge away from it... 2) This action of the rays is strictly unipolar; a positive charge is not carried away by the rays ... 4) Rays of the very highest refraction, which are lacking in the solar spectrum ($\lambda < 295 \times 10^{-6}$ mm), have the discharging property—if not exclusively, then at least to an enormously greater degree than others ... 6) with minor differences, all metals possess this sensitivity, but it is especially acute in certain dyestuffs (aniline dyes). 7) The discharging property of the rays is observed even under very brief illumination, and no appreciable time elapses between the illumination and the corresponding discharge ... 11) No matter what the mechanism of the actinoelectric discharge, we are correct in regarding it as a certain current of electricity."

The talented self-taught physicist I. F. Usagin (1855—



Leonid Isaakovich Mandel'shtam
Editor of JETP from 1931 through 1939

Nikolaĭ Nikolaevich Andreev
Editor of JETP from 1952 through 1956

Sergei Ivanovich Vavilov
Editor of JETP from 1939 through 1952

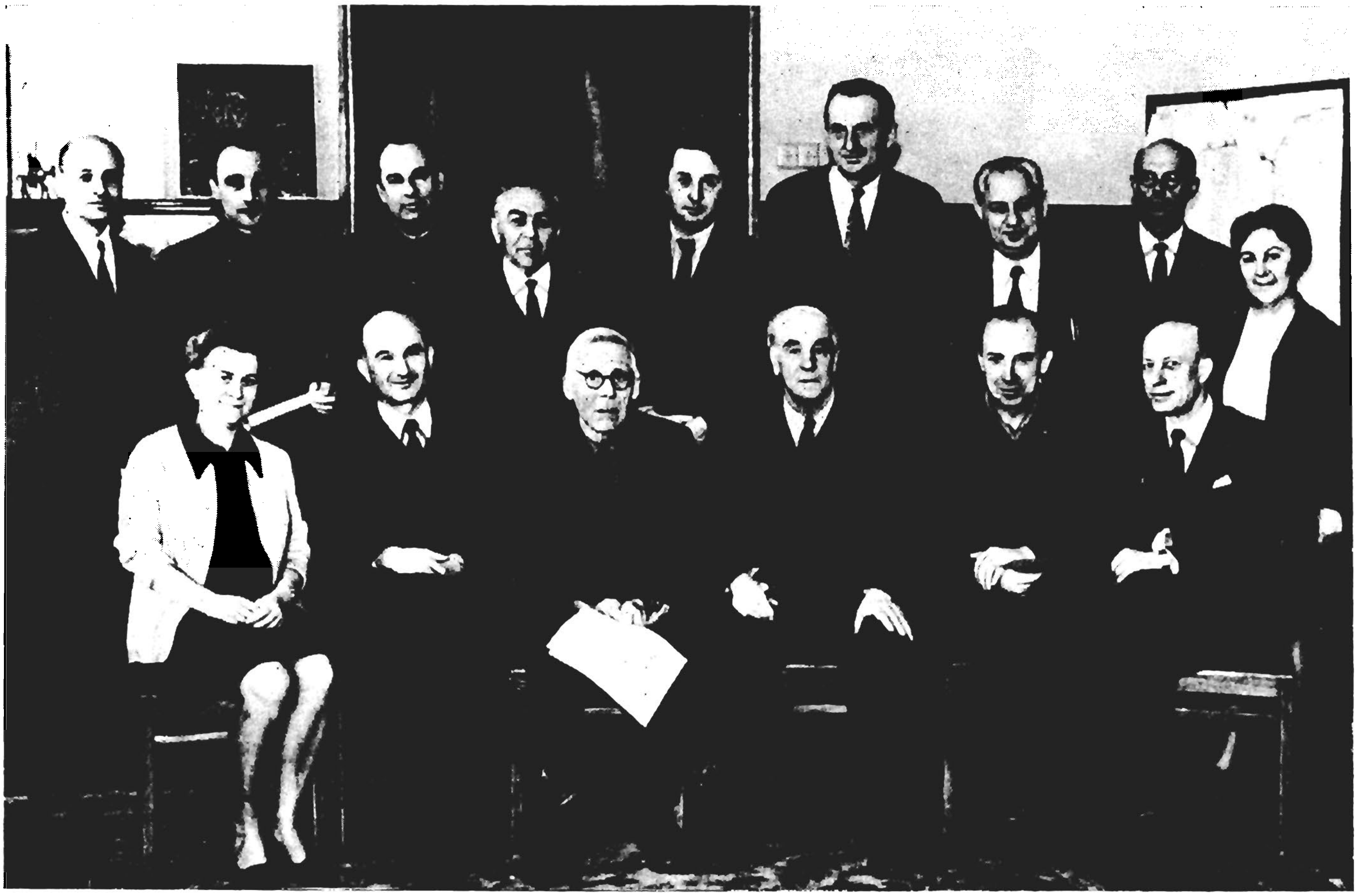
1919), Stoletov's irreplaceable assistant in his teaching and scientific work, was a figure of no small importance in the development of the Moscow University physics laboratory. Thanks to Usagin, the level of the demonstration experiment was very high at the university. Usagin's contribution to the "actinoelectric investigations" was acknowledged specifically by Stoletov himself:

"My entire study was carried out with the untiring assistance of my skilled and gifted laboratory assistant I. F. Usagin, whose interest in the work was equal to mine throughout its performance. He must be credited not only with the material fabrication of the coils and appliances, but also for his valuable practicable suggestions regarding the most convenient design of the experiments. I consider it my duty to thank I. F. Usagin, who has earned all of my gratitude."

The work of Stoletov's student V. A. Mikhel'son (1860–1927), who was for a long time a professor at the Agricultural Academy, pertains to the same period. In his paper on "An Attempt at Theoretical Explanation of the Energy Distribution in the Spectrum of the Solid Body" (19A, 79 (1887)), Mikhel'son made one of the first attempts to derive a formula for the energy distribution in the black-body emission spectrum from kinetic considerations.

Mikhel'son's fundamental work pertains to a totally different field—the physics of combustion. In 1890, Mikhel'son reported "On a Physical Theory of the Bunsen Flame," a term applied to any steady flame formed on ignition of a jet of explosive gas flowing out of a cylindrical tube (22A, 94 (1890)). Most of the explosive gas burns in a single very thin layer (for which the term "surface of ignition" was suggested) whose temperature is much higher than that of the entire remainder of the flame. The shape of its surface depends exclusively on two factors: 1) on the velocity and direction of the jet of explosive gas and 2) on the "normal ignition velocity" of the burning mixture, i.e., the velocity with which a plane ignition surface would advance in the explosive mixture perpendicular to its own direction while the part of the gas that had not been ignited remained at absolute rest. This paper of Mikhel'son marked the beginning of the development of the important and complex problems of combustion and detonation physics.

Actually, the Physical Society existed in Russia only with financial support from private individuals and was



The editorial staff of JETP (1972). Seated (from left to right): Z. P. Bunakova, E. M. Lifshitz, M. A. Leontovich, P. L. Kapitza, A. S. Borovik-Romanov, S. Yu. Luk'yanov; standing: É. I. Rashba, V. N. Gribov, I. I. Sobel'man, V. P. Dzhelepov, I. E. Dzyaloshinskiĭ, A. M. Prokhorov, É. L. Andronikashvili, G. F. Zharkov, L. A. Puzanova.

constantly in financial difficulty. The frugal language of the minutes of the Society's meetings convey to us the difficult situation of that time:

"On 25 April 1889, V. V. Lermantov, Treasurer of the Physics Division, reports that the wooden hut set up in the courtyard of the university astronomical observatory for geophysical observations had fallen into a decrepit state and should be either restored or removed. Since we have no need for it at the present time, the decision has been taken to authorize Treasurer Lermantov to sell it before it collapses completely."

In 1894, the JRPCS carrier an article by B. L. Rozing (1869–1933) in which he described his studies of the magnetostriction of iron in cyclical magnetic fields (26A, 253 (1894)). The design of the experiment was highly elegant. The elongation of a wire on magnetization was measured with Newton rings, and the motion was transmitted by a system of levers. Rozing succeeded in attaining a sensitivity of 10^{-6} mm in this method. This enabled him to make the first observations of magnetostrictive hysteresis. It is interesting to note that the basic principle of wireless image transmission with the aid of inertialess electronic devices and the first attempt to apply it are due to Rozing. In 1907, he applied for a patent on a method for electrical transmission of images over a distance, and in 1911 he demonstrated television transmission of an image of four parallel light lines.

A result of development of Maxwell's electromagnetic theory was the paper by A. I. Sadovskiĭ (1859–1920) on the rotary effect of a polarized light wave on a plate through which it passes (29A, 82 (1897)). Working from a static analogy (a dipole placed in an electric field experiences a torque), Sadovskiĭ made use of the fact that the polarization vector does not coincide in direction with the field-intensity vector in an anisotropic medium in arriving at the conclusion that a light (electromagnetic) wave also has a mechanical orienting action in an alternating field. A crystal plate that transforms plane-polarized electromagnetic waves into elliptically polarized waves, i.e., into a rotating electromagnetic field, has itself a tendency to rotate in the direction opposite to that of the rotation of the electromagnetic forces. But if a flux of circularly polarized electromagnetic waves acts on the plate, it tends to turn in the direction of rotation of the vectors of the incident beam (an orienting force appears). In the case of rotation, "the moment equals half the total quantity of energy that can be transmitted through the plate within one period or, more precisely, the amount of energy carried through the plate solely by electrical forces during a single oscillation." The effect suggested by Sadovskiĭ was found to be very small, according to an estimate that he made for the case of sunlight: $\sim 10^{-9}$ erg/cm^2. The Sadovskiĭ effect was observed experimentally in 1935 by the American physicist R. Beth.

The electromagnetic theory of Maxwell, which had been confirmed brilliantly in the nineteenth century by the labors of scientists in many countries, entered a new phase in its development in 1895—a phase of practical applications. This transition is linked to the name of the outstanding Russian scientist A. S. Popov (1859–1905). After graduating from the St. Petersburg University, Popov worked as an instructor of torpedo officers at Kronstadt, and, beginning in 1904, in the physics department of the electrical Engineering Institute.

At the 151st session of the Physics Division of the Russian Physicochemical Society on 25 April (7 May) 1895, A. S. Popov submitted his report "On the Response of Metallic Powders to Electrical Oscillations." As recorded in the minutes, "by using the high sensitivity of metallic powders to very weak electrical oscillations, the speaker had constructed an instrument designed to indicate rapid oscillations in atmospheric electricity."

Popov described his receiver in a paper entitled "A Device for Detection and Registration of Electrical Oscillations" (28A, 1 (1896)). In 1891, Branly had discovered that metallic powders have the ability to change their resistance to electric current instantaneously if an electrophorous or induction machine is discharged near them. The filings can be returned to their original high-resistance state by mechanical shaking. Popov took upon himself the task "of finding a combination such that the relation established among the filings by the electrical oscillations will break down instantly and automatically." This led to the development of the instrument.

A tube containing filings was suspended horizontally between terminals on a light watchspring. A bell was mounted above the tube in such a way that when it rang, its clapper would tap gently on the middle of the tube, which was protected from breakage by a rubber ring. Battery current circulated constantly from one terminal to a plate, thence through the powder in the tube to the other plate, and through the winding of an electromagnetic relay back to the battery. This current was not strong enough to pull up the relay armature, but if the tube was subjected to electrical oscillations, its resistance would decrease instantaneously and the current would increase to the level at which the relay armature would be pulled up. At this time, the circuit from the battery to the bell would close and the bell would begin to operate, but the vibration of the tube would again lower its conductivity and the relay would open the bell circuit.

Popov's conclusion: "... this instrument, or a later improvement thereof, can be used to transmit signals over distance with the aid of rapid electrical oscillations as soon as a source of these oscillations with sufficient energy is found." As we know, Popov gave the world its first demonstration of radio transmission and reception of an intelligible text from one building to another, over a distance of about 250 meters, on 12 (24) March 1896. The world's first radiogram consisted of two words: "Heinrich Hertz," the name of the scientist who had been first to observe electromagnetic waves.

The first emergency use of the wireless telegraph was made in 1900, during the rescue of the ironclad "General-Admiral Apraksin;" the rescue of the ship after uncommonly strenuous efforts during which messages were transmitted over 43 km was greeted with enthusiasm by mariners and became an occasion for national rejoicing.

Unfortunately, disputes soon arose in regard to priority in this invention. In 1906, after Popov's death, the Physics Division of the RPCS therefore appointed O. D. Khvol'son, N. G. Egorov, N. A. Bulgakov, and A. L. Gerasimov to a commission charged with preparing a report on the scientific importance of Popov's work. After examining all publications with a bearing on the question and soliciting the opinions of O. Lodge and E. Branly, the commission arrived at the conclusion that "... according to the data at our disposal, and regardless of other circumstances in the history of this invention, A. S. Popov should rightly be recognized as the inventor of the electric-wave wireless telegraph.

"... We, the contemporaries of A. S. Popov, whose memory lives on, his comrades, his students, and his admirers, have not yet forgotten his experiments, his honorable and modest spirit, his honesty, his original mind, and his talent as an experimentor."

In 1906, a prize was instituted "in the name of A. S. Popov, inventor of the wireless telegraph, for superior original research and invention in electricity and its uses, carried out in Russia and reported in the Russian language."

THE FIRST DECADES OF THE TWENTIETH CENTURY

At the turn of the century, erection of the magnificent edifice that is modern physics was proceeding at a rapid tempo. Foremost among the constructors was the noted Russian scientist Petr Nikolaevich Lebedev (1866–1912) with his work on light pressure. An excellent supervisor and organizer, Lebedev created a school of physicists at Moscow University that was to determine the character of Russian science in many respects.

In 1900, the journal carried Lebedev's article on "The Maxwell-Bartoli Pressure Forces of Radiant Energy" (32A, 211 (1900)). That an alternating electromagnetic field should exert a pressure was a consequence of Maxwell's own theory, and in 1876 Bartoli had argued in favor of the existence of light pressure on the basis of thermodynamic considerations. This gave Lebedev's paper its title. However, many physicists did not regard the existing theoretical conclusions as convincing, and doubted the existence of the effect, which had never been detected experimentally.

The principle of Lebedev's experiment was extremely simple; it aimed to use a torsional balance to measure the angle of rotation of a vane wheel with light incident on one of its sides. However, the difficulty of experiments of this nature consists in the fact that illumination of small, thin discs gives rise not only to light pressure, but also radiometric forces, which depend on the temperature difference between the two sides of the vanes, and convective currents of gas. To eliminate the effects of convection, Lebedev directed the luminous flux first onto one side of a vane and then onto the other. To eliminate the effects of radiometric forces, he used vanes of different thicknesses and was therefore able to calculate the deflection at zero thickness, when there are no radiometric forces, he also obtained a degree of rarefaction in the measurement volume that was high for his time.

In Lebedev's apparatus, light from an arc lamp was focused on a diaphragm by condensers. A lens converted the beam from the diaphragm into a parallel pencil. A plane-parallel vessel containing water was placed in the path of this pencil to absorb infrared rays with wavelengths longer than 1.2 μ. For their part, the glass lenses blocked out ultraviolet light. Then, after reflection from mirrors and focusing by a lens, the pencil was directed onto a vane enclosed in a glass bulb. The beam could also be aimed at the vane from the opposite side. Vanes were made from platinum, aluminum, nickel, and mica. The energy of the incident rays was measured with a calorimeter.

Reduction of his measurements enabled Lebedev to conclude that: "The experiments indicate that a beam incident on reflecting or absorbing surfaces exerts upon them a pressure equal to the Maxwell-Bartoli light pressure within the limits of observational error." At the end of his article, Lebedev notes that: "Application of light pressure is of interest. The repulsive force of the sun's radiation must be an important factor in the motion of comets. Deformation of the shapes of comets was observed long ago, but no satisfactory explanation has thus far been offered for it. Many physical factors are significant, but one that must unconditionally be reckoned with is light pressure."

The discovery of radioactivity was one of those that determined the development of contemporary physics. One of the first Russian physicists to understand the importance of the new phenomenon was Ivan Ivanovich Borgman (1849–1914). "A member of the Physical Society since its earliest years, Borgman took upon himself the extremely difficult and responsible job of editor of the Society's journal. He carried this responsibility without interruption for nearly thirty years (1875–1902), and only when, invested with the high confidence of his colleagues, he was called upon to take over the position of the first elected director of St. Petersburg University during a most difficult time and was, at the same time, made a scientists' representative to the State Council, did he conclude that he was physically unable to give the journal as much of his time as he had during the preceding thirty years and request the Society to relieve him of his editorial responsibilities,"—thus spoke A. N. Krylov at a session dedicated to Borgman's memory (46A, 254 (1914)). Borgman did a great deal to improve the quality of instruction at the St. Petersburg University and to disseminate the ideas of Maxwellian electrodynamics.

In 1896, working with A. L. Gershun, Borgman repeated J. J. Thomson's observations of the loss of charge by bodies exposed to x-rays. After the work of Elster and Geitel, who had detected the presence of radioactive material in the healing muds of an Italian health resort near Padus, Borgman investigated several Russian healing muds for radioactivity (36A, 183 (1904)).

The observations confirmed the existence of radioactivity in some of the Russian healing muds. He also wrote in this connection that "I became interested in the question as to how a healing mud might affect bacteria if it were radioactive." The observations were made by Doctor Lasdon at the Institute of Experimental Medicine. Here is the answer: "I am convinced beyond a doubt that an emanation that inhibits the growth of bacteria is emitted from my mud samples ... The question arises, of course, as to whether the emanation from the mud has any part in the therapeutic effect. There is nothing improbable about this hypothesis. I have become convinced by numerous direct experiments that any living tissue radioactivated under exposure to the emanation of radium enters an inflamed state."

The year 1905 began tragically for Russia. On 9 January, a peaceful procession of St. Petersburg workers carrying a petition to the Czar at the Winter Palace was shot down without mercy. Only 16 persons attended the session of the Physics Division on 11 January. Borgman, who was presiding, read to those present a statement, signed by 31 members, which he had just received. The letter read: "Profoundly shaken by the bloody events that have taken place during recent days at St. Petersburg, we, the undersigned, find ourselves unable at this time to pursue our scientific work and humbly request postponement of today's session, submitting our petition to the members of the Division who are present at the meeting" (37A, 46 (1905)). On that day, the meeting was confined to the business part of the agenda. The report of the Society for 1905 notes that: "During the present reporting year, the scientific activity of the Physics Division was more subdued than in previous years. This observation, which could be made for many of the scientific societies of Russia, is undoubtedly a result of the social upheavals by which the entire country is convulsed."

In 1906–1908, the JRPCS published a series of papers by A. R. Kolli, a student of P. N. Lebedev (and the son of R. A. Kolli, whom we mentioned earlier) and lecturer at Novorossiĭsk University (Odessa). These articles were concerned with the highly important question as to the normal and anomalous dispersion of long electromagnetic waves in various media. In the first article "On the Use of the Wire-Wave Method for Investigation of Dispersion in the Electrical Spectrum of Liquids, and Measurement of the Electrical Refractive Index of Liquids" (38A, 431 (1906)), Kolli developed a method for exciting electromagnetic oscillations (in the decimeter range) in a Lecher waveguide system, and used this method in an investigation of wave dispersion in water and various organic liquids (39A, 210 (1907); 40A, 121, 228 (1908)).

These works of A. R. Kolli were the pioneering studies in the field of radiospectroscopy. Kolli's apparatus contained all of the basic elements of modern spectroscopes: 1) an exciter (generator) of electromagnetic waves that permitted smooth variation of wavelength in a certain range; 2) a waveguide in the form of parallel wires (Lecher wires); 3) a device for measurement of wavelength; and 4) an indicator (receiver) of the electromagnetic oscillations.

His studies of the electrical spectra of various liquids led Kolli to important conclusions; bodies that are chemically related (benzene, toluene) or have the same group in their molecules (toluene and acetone) have identical absorption bands in their electrical spectra. He wrote that "This relation between the structure of the spectrum and the chemical composition of the substances has been obtained for the first time in this range of wavelengths, i.e., certain chemical groups are characterized by certain spectral bands." Thus was discovered the relation between the chemical structure of substances and their electrical spectra, with Kolli himself observing immediately and correctly that the bands of the electrical spectrum are due not to atoms, but to the molecular structure, and represent the spectrum of the molecules.

Borgman's successor as editor of the JRPCS from

1903 through 1907 was Nikolaĭ Aleksandrovich Bulgakov (1872–1935), a professor at the St. Petersburg University; he was followed, through 1911, by Vladimir Konstantinovich Lebedinskiĭ (1868–1937), one of the prominent Russian investigators of electricity and radiophysics during the first half of the twentieth century. Lebedinskiĭ played a major role in reorganization of the journal.

Events had unfolded historically in such a way that chemistry was stronger than physics in Russia during the nineteenth century. Both in the Society and in its printed organ, chemistry literally flattened physics, occupying, for example, three or four times as much space in the journal. It was suggested that the Society be partitioned and that the chemical and physical parts of the journal be published separately. We read in the minutes of the 237th session of the RPCS's Physics Division, which was held on 13 December 1905: "Since the Chemical Part of the JRPCS has expanded sharply and it is therefore necessary to raise the subscription price of the journal, the Council of the Physics Division and the journal commission have arrived at the following conclusion. A high subscription price would be a heavy burden to those subscribers who are interested chiefly in the Physical Part of the journal. This runs counter to one of the objectives pursued by the Physics Division, namely, the dissemination of physical knowledge, since there will undoubtedly be a sharp decrease in the number of subscribers, as there was in 1885, when the subscription price was raised from 5 to 8 rubles. Then the number of subscribers fell from 266 to 189 ... The Council of the Physics Division and the Journal commission find themselves obliged to concur with the 1906 price rise in order to get the journal divided into two parts.... Further, the journal commision considers it possible to improve the second part of the Physics Division of the journal, and proposes the following measures to this end: "To elect a special commission that would be concerned exclusively with the abstracts section, i.e., list reviews and papers for abstracting, find abstractors, etc. ... As for the first part of the journal's Physics Section, it has long been common knowledge that far from all original Russian papers in physics are printed in the JRPCS. The enlistment of all Russian physicists for collaboration in the journal must therefore be the objective of both the journal commission and the editor, as well as of the membership of the Physics Division in general" (37A, 349 (1905)).

After prolonged discussion, both at the general meetings of the entire Society and in its two divisions, it was decided not to break up the Soceity, but to publish the physical and chemical parts of the journal separately, preserving the old title "Journal of the Russian Physicochemical Society" and the numeration of the volumes, which would henceforth be published with the appropriate appendage: Physical Section or Chemical Section (39A, 34 (1906)).

The demands that this placed on the editor of such a journal are readily appreciated: in addition to high scientific qualifications, he needed better-than-average ability as an organizer. V. K. Lebedinskiĭ, whose activity in the journal "Electricity" was well known to the members of the RPCS Physics Division, was recognized as the best candidate for this important and responsible post. Lebedinskiĭ was chosen as editor of the physical Part of the JRPCS at the next session of the Division, which was held on 29 December 1905 (38A, 58 (1906)).

In summarizing the first year of his work, Lebedinskiĭ wrote in the editor's report for 1907 that "During the reporting year, the 34th year of its existence, the Journal of the Physics Division has entered a new phase in its life. Having been separated from the Chemical Part of the JRPCS, it has become an independent physics publication. Its independent publication and the improvement of its format have naturally been parts of a general effort to elevate the journal and broaden its role in the scientific movement of our country. Many representatives of our Division find that our journal does not adequately represent the present state of physical science in Russia, and that the cause of this is to be sought in the absence of unanimous support among Russian physicists for the creation of such a central organ. The council of the Division has distributed a circular to 67 persons, asking them to send their papers to our journal, even if they were originally intended for another publication, or abstracts of their articles and other scientific works. This circular was written by O. D. Khvol'son, and its fate has at least been happier than that of a similar initiative of the Council in 1902; 14 individuals responded to the suggestion, and P. N. Lebedev went into particular detail in expressing his sympathy with us in this matter. And it would appear that the Division has little left to do before it can be said of the lofty purpose of the first section of the journal—to reflect in its entirety the work done by Russian scientists in physics—that it has been accomplished" (40A, IV (1908)).

Lebedinskiĭ regarded the dissemination of advanced scientific ideas among all educated Russians who were interested in physics as one of the principal purposes of the scientific periodical. Lebedinskiĭ therefore suggested that the second section of the Physical Part of the JRPCS, which contained reviews, abstracts, physics bibliographies, and articles devoted to laboratory practice, also be published as a separate journal, which would be called the "Problems of Physics" after a suggestion of K. K. Baumgart.

In the aforementioned report on his first year as editor, Lebedinskiĭ noted with satisfaction that the new journal that he envisaged had acquitted itself well, and that the entire active staff of the RPCS Physics Division had participated in its creation. He wrote "The success of this venture is explained by the support given it by a long list of individuals; even by the end of 1905, the abstracts commission had been formed under O. D. Khvol'son, I. I. Borgman, and D. S. Rozhdestvenskiĭ, and had drawn up the first list of subjects, some of which were completed only during the reporting year, while others are still in search of writers. These reviews are either the result of independent study by the author in some field of our science or the product of younger physicists working under the supervision of individuals with experience in scientific writing. There is probably no doubt in anyone's mind as to the usefulness of this work in making it easier for us to follow the science, as a teaching aid, as the first venture of the aspiring author, or in supplying serious reading matter for the young physicist. The significance and growth of the second section of our journal suggests that it should become an independent periodical for a wider circle of readers than that of the entire Journal of the Physics Division taken as a whole."

In 1911, the difficult task of managing two journals with contents of sharply different nature was divided among several members of the Division by establishing an Editorial Committee consisting of persons appointed to two-year terms. Most of the Editorial Committee's activity was in the editing of articles intended for the "Problems of Physics," and preparation of materials for this part of the Journal of the Physical Society (JPS). The editors in 1911 were A. F. Ioffe, N. P. Kasterin, P. P. Lazarev, P. N. Lebedev, D. S. Rozhdestvenskiĭ, and P. S. Ehrenfest. We should note that abstracts of nearly all articles published in French and German had begun to appear in the Journal back in 1900.

Aleksandr Aleksandrovich Éĭkhenval'd (1863–1944) emerged as one of the most prominent of the Moscow physicists at the beginning of our century. In 1901–1903, he carried out a series of experimental investigations concerned with the study of electromagnetic processes in moving media. Éĭkhenval'd was the first to make quantitative measurements of the magnetic field of the so-called Roentgen current, i.e., the magnetic field of bound charges in a dielectric that are in motion together with the substance (36B, 39 (1904)). These experiments played a decisive role in the choice between two variants of the electrodynamics of moving media (those of Lorentz and Hertz) in favor of the Lorentz theory (the Lorentz electrodynamics in its first order corresponds to the electrodynamics of relativity theory).

Éĭkhenval'd was a broadly educated man with interests of considerable variety and scope. Among his friends were the physicists Lebedev, Tsinger, and Kravets, the mathematician Mlodzeevskiĭ, the opera director Kochetov, and the crystallographer Vul'f. He was attracted by photography, which was then only in its infancy, was a fair pianist, and even wrote and published a few novels. Éĭkhenval'd's attitude toward scientific work is best seen in his own words, which we take from a speech on the subject "Matter and Energy" made at the concluding general meeting of the 12th Congress of Natural Historians and Physicians in 1910. Taking exception of the views of Kirchhoff and Mach on the purposes of scientific research, Éĭkhenval'd spoke as follows:

"Kirchhoff and Mach say that the purpose of science is to give a complete description of the phenomena of nature and to make this description as simple and economical as possible. Suppose that this is true. But I ask you: Can the idea of economy ever generate enthusiasm, even in science? Scientific work cannot be done without enthusiasm. Ask any scientist what he needs to work successfully in the scientific arena. He will tell you that he needs knowledge, skill, and many other things, but first of all enthusiasm, uninhibited enthusiasm for science; if you have no enthusiasm, forget it—you will get nowhere!

"But what are scientists enthusiastic about? Certainly not economy, not because they have succeeded in binding several fields of knowledge together into a single whole, but because from the height of the peak that they have gained they can see beauty that comes as a complete surprise to them. They see that the fields that they have bound together are not as sharply different from one another as they had appeared to be at the beginning of their study; it becomes evident that they have much in common, that they even stand in a certain familial relationship, in a harmony of the same kind as, for example, that of two notes of the same chord. And the higher the scientific principle, the greater will be not only the number of different fields of knowledge that can be unified, but also the degree of harmony in the resulting unity. One experiences a quite special kind of complete esthetic enjoyment, and it is this that fascinates us with scientific work and makes us forsake everything else for it."

In 1908, six years after his work on the pressure of light on solid bodies, P. N. Lebedev succeeded in demonstrating experimentally the existence of light pressure on gases (40A, 20 (1908)). This was a still more complex task, since the quantity to be be measured in this case is 1/100 as large as in the case of pressure on solids. It was necessary to measure a pressure of $\sim 10^{-6}$ dyn/cm^2. A detailed article on these experiments appeared in 1910 (42A, 149 (1910)).

Each molecule of the gas experiences pressure, i.e., a force that tends to make it move in the direction of the beam. To detect this force, the gas under study (methane, propane, acetylene, carbon dioxide) was pumped into a container with vertical fluorite walls. The container was partitioned internally by a vertical metal wall that did not extend to the fluorite windows, so that two communicating chambers were formed; if a horizontal beam of light was projected down the first chamber from the front window, the gas would begin to move in the direction of the light beam and, reaching the rear window, would accumulate there and spread out laterally into the adjacent chamber, in which there was no light; in this chamber, it would reverse direction and then flow back around the window and reenter the light beam in the first chamber from the sides.

For measurement of the pressure, the gas flow in the second chamber could be (almost) shut off with a lightweight sliding piston suspended from the arm of a torsional balance, whose deflection was used as a measure of the absolute pressure to which the gas was subject in the direction of motion of the light. To prevent nonuniform heating of the gas, which would set it in thermal motion, Lebedev added hydrogen to the gas to obtain quick equalization of its temperature. Lebedev's conclusions:

"1) The existence of light pressure on gases has been established experimentally. 2) The magnitude of this pressure is directly proportional to the energy of the beam and the absorption coefficient of the gas. 3) Within the limits of observational and calculating errors, the relation given by Fitzgerald is in quantitative agreement with the observations. Thus, the hypothesis of light pressure on gases, which had been advanced three hundred years previously by Kepler, has now been confirmed both theoretically and experimentally."

These experiments definitely made Lebedev's reputation as one of the cleverest of experimentors, and while the pressure of light on solids has also been measured by other scientists who followed him, no one has reproduced the experiment in which he determined the pressure of light on gases.

We have already noted that Lebedev's laboratory at

Moscow trained a whole constellation of outstanding scientists. Work was done in many areas simultaneously; for example, Lebedev's student N. P. Neklepaev carried out the first studies in molecular acoustics in its ultrasonic range, which was not fully developed until after the Second World War. Neklepaev's paper was entitled "An Investigation of the Absorption of Short Acoustic Waves in Air" (43A, 101 (1911)).

Back in 1907, V. Ya. Al'tberg (also a representative of Lebedev's school) had found it impossible to produce acoustic waves shorter than 1 mm (39A, 53 (1907)). Lebedev showed that this may be due to absorption of the short acoustic waves. Neklepaev excited short acoustic waves with the electric spark of a discharging capacitor placed at the principal focus of a concave mirror. The beam of parallel rays from this mirror was directed onto a diffraction grating, and the beam deflected by the grating was directed by a second concave mirror to a sound-pressure measuring device. The measurements were made in the range of λ from 2.5 to 0.8 mm; the absorption coefficient of the waves was found to be inversely proportional to λ^2.

The productive activity of Lebedev and his school, with its exceptional importance for Russian science, was interrupted by Czarist reaction. In 1911, Minister of Public Instruction Kasso, carrying out the policies of ruling circles, who wished to eliminate all traces of the reforms gained in the revolution of 1905 in the area of public instruction, ordered the dismissal of Rector Manuĭlov and two vice rectors, Menzbir and Minakov, who had been in charge of day-to-day activities at Moscow University. [On 11 January 1911, the Council of Ministers issued a proclamation prohibiting student assemblies within the walls of higher educational institutions and ordering the police to take speedy and decisive measures against them, i.e., placing the police in charge of the university, Rector Manuĭlov reported to the Council of the university on the resulting situation and told it that under such conditions he found it impossible to bear the responsibilities of Rector. His assistant M. A. Menzbir and Vice Rector P. A. Minakov, taking Manuĭlov's side in this matter, submitted similar statements]. As a sign of protest against Kasso's policy, more than 100 professors, lecturers, and assistants, including Lebedev, left the university.

The Physics Division also responded to the events in Moscow. On 8 March 1911, N. G. Egorov chaired a meeting of the Division. This was apparently one of the most tumultuous sessions that had ever been held in the history of the Physics Division. In February of 1911, a group of progressive-minded members of the Division, including Ioffe, Ehrenfest, Dobiash, Khvol'son, Fridman, and Gezekhus, had submitted to the Division Council a statement in which they proposed that a protest be made in the name of the Division against the dismantling of Moscow University, with an expression of sympathy for the professors who had resigned. The Council had rejected this statement. The question was brought up again at the March session. Most of the speakers objected to the decision of the Council, and the following resolution was adopted as a result by a majority of 37 votes to 16:

"The Physics Division of the Russian Physicochemical Society cannot remain silent in the midst of the grave crisis that has overtaken the Physics Institute of Moscow University.

"This crisis has interrupted the scientific work of scientists, whose investigations have occupied a prominent place in the scientific system of modern physics. The theoretical value of these investigations and the skill with which scarcely palpable effects have been subjected to precise measurement have been recognized for their merit in world physics literature.

"All who value the development of physics in Russia had watched with deep satisfaction the growth and development of an exemplary school of physicists at Moscow. This school has managed to provide other universities with physicists who carry on the best teaching traditions and inspire scientific initiative. The Moscow school is a viable and developing organism that has established continuity from basic instruction in the general courses through broader development in special courses taught by university lecturers to the ultimate introduction to independent research and preparation for teaching activity in the laboratory and seminar ....

"Now the present crisis has exploded in the midst of this concentrated activity. We cannot rest content with the thought that the oldest Russian university may be deprived of its exceptionally valuable school of physicists, and hope that there will come a time at which its representatives can again return to the halls of the Moscow University Physics Institute" (43A, 206 (1911)).

Abram Fedorovich Ioffe (1880—1960), a prominent physicist and an organizer of Soviet science, had become a member of the RPCS in 1906. Ioffe immediately assumed an active part in the Society's activity, was several times appointed to various commissions, and regularly submitted papers at sessions of the Division on his own scientific research.

In 1910, Ioffe undertook to establish whether a magnetic field exists around cathode rays, which are directed beams of electrons in vacuum (43A, 7 (1910)). Until that time, there had been no direct experimental proof that cathode rays are magnetically active. To the contrary, all attempts in this direction had produced negative or uncertain results.

Ioffe's instrument consisted of a discharge tube with a Wehnelt cathode and a brass anode plate. The cathode beam passed through a diaphragm into a second tube that was wrapped in metal foil and coated internally with a thick layer of silver with a metallic connection to the anode. A hollow ball connected to the anode across a galvanometer was placed at the end of the tube. The magnetic system consisted of magnets that were suspended on a quartz filament and shielded by iron armor plates from oscillations of the external magnetic field, electrical effects, and air currents. The deflection of the magnets was supposed to correpond to the current indicated by the galvanometer.

Ioffe's conclusions were laconic: "The observations described above establish the existence of a magnetic field of cathode rays. Quantitatively, the field agrees within the limits of error attained (5%) with the field of an equivalent current carrying the same quantity of electricity. Thus, there is no difference between a stream of free electricity and currents in metals in regard to the magnetic fields that they produce. The negative results obtained in all previous efforts are explained entirely by the design of the experiments."

Ioffe's experimental work had been done impeccably.

His results actually marked the culmination of a series of studies long since initiated by Éĭkhenval'd. They demonstrated convincingly that the mechanism by which the magnetic field appears is the same irrespective of its origin.

However, Ioffe's main interest was in study of the properties of solids. Anticipating somewhat, we mention that in 1916, working with M. V. Kirpicheva, Ioffe published a paper entitled "The Electrical Conductivity of Pure Crystals" (48A, 261 (1916)). Ammonium and potassium alums were investigated as representatives of crystals with water of hydration and sodium and silver nitrates as representatives of anhydrous crystals. Before Ioffe began his studies of the electrical properties of dielectric crystals, the physical picture of phenomena in them had been so confused that the entire problem had been referred to as a kind of dielectric anomaly. The article states that: "It is customary to regard the atoms as the elements of crystals. However, we feel that it would be more correct to say that the basic elements of crystalline structure are electrolytic ions in most transparent crystals and, probably, metallic ions and electrons in metallic crystals." Farther on, we read: "It seems to us that all of the facts cited above fit perfectly into the following picture of the crystal's internal structure. A crystal consists of alternating oppositely charged ions. Under mechanical, temperature, electrical, and optical disturbances to the crystal, the ions are shifted away from their equilibrium positions as a single entity, together with the charge that they carry .... Study of the electrical conductivity of crystals is of special interest because it is precisely here that we first encounter pure ions—ions that are not bound to molecules of their environment."

In 1911, the journal published E. A. Kirillov's experimental paper "Anomalous Dispersion in Lippmann Color Photographs" (43A, 405 (1911)). Its purpose was to detect the anomalous-dispersion phenomenon in color photographic plates prepared by the Lippmann method. [A Lippmann color photograph is a photographic plate in whose volume a system of interference fringes is produced as a result of reflection of monochromatic light from a layer of mercury on which the plate is placed.] It was to serve as a "proof of the possibility of artificial preparation of a medium that exhibits anomalous dispersion for desired wavelengths (wavelengths close to one another in a selective-reflection band)."

In the experiment, layers of dispersing material were placed in one of the arms of an interferometer. The system of interference fringes was observed. On insertion of the layer, these lines were deformed in the vicinity of the absorption band, assuming a shape similar to that of the dispersion curve at the absorption band. Sheets were sandwiched to enhance the effect. As the number of these layers was increased, the anomalous-dispersion effect also became stronger.

We know now that artificial laminar structures came into extensive use only 50 years later, as reflectors for modern lasers.

Finally, Petr Petrovich Lazarev (1878–1942), Lebedev's student and successor, was the author of yet another remarkable paper of 1911. Lazarev's article was entitled "On the Temperature Discontinuity in Heat Conduction at the Boundary Between a Solid and a Gas" (43A, 69 (1911)). The kinetic theory of gases requires that the coefficient of thermal conductivity be independent of pressure. However, as had been shown by Smolukhovskiĭ, who was the first to undertake systematic reduction of the experimental data, agreement with these data can be obtained only on the assumption that a nonzero pressure-dependent temperature difference can appear at the solid-gas boundary during heat transfer. Temperature distributions in gases had not been measured before Lazarev.

The author measured the distribution of temperature in various layers of gas between two parallel horizontal surfaces; to prevent convection, the lower plate was the colder one. The temperature distribution in the gas was measured with a platinum-constantan thermocouple. Lazarev's work consisted of: 1) an investigation of the temperature variation between the surfaces for air; 2) determination of the size of the temperature jump and its dependence on pressure for air, carbon dioxide, and hydrogen; 3) measurement of the temperature variation in the discontinuity at wavelengths exceeding the dimensions of the vessel.

The results showed that a temperature discontinuity arises at the boundary during heat transfer from a solid to a gas and that its magnitude agrees closely with Smoluchowski's theoretical prediction.

Lazarev was later the head of the Physics Institute at Moscow (1915), and organized the school of Soviet biophysicists.

In 1913, the journal printed an article by B. B. Golitsyn entitled "Principles of Instrumental Seismology" (45B, 31 (1915)). Golitsyn read this paper at an International Congress at Manchester, at which he was elected chairman of the International Seismological Association. Golitsyn was distinguished as the organizer of the Seismological Service in Russia. He was the first to build an automatic seismograph with galvanoelectric registration for detection of distant earthquakes, and set up a network of seismological stations in Russia. In 1911, Golitsyn became the first in Russia to teach a systematic course on seismology for individuals who had expressed a desire to work in this field, Speaking at the Manchester congress, Golitsyn stressed that:

"The rapid development of seismology over the past 10–20 years must be attributed almost exclusively to the fact that seismology stood on solid ground, having developed purely physical research methods based on instrumental observations." Golitsyn himself had a major role in the inculcation of physics into seismology.

Golitsyn's work on molecular physics (the critical state) and the thermodynamics of radiant energy are of no lesser importance. In his master's thesis (1893), he was the first to attribute a definite temperature to the electromagnetic field and in fact arrived at Wien's law. Golitsyn departed from generally accepted premises in these studies and therefore unfortunately incurred the displeasure of even such prominent Russian physicists as Stoletov.

The Physical Society regularly received requests for exchanges of publications, advertisements, and requests for free copies of the journal. Between the lines of this correspondence one senses the increased importance of the Physical Society, changes for the better in public instruction, and echoes of the political life of Russia.

1907. The Chairman reports to the Division a request from the Director of the Odessa Advanced Women's

Courses that complimentary copies of the Physics Section of the journal of the RPCS be sent to their library. The Division votes to send its Journal to the Odessa Advanced Women's Courses.

1908. I. N. Evstratov submits a request for complimentary copies of the journal on behalf of a physicomathematical club recently organized by exiles on the Angara. Request granted.

1909. A request for complimentary copies of the "Problems of Physics" is received from Afanasiĭ Ivanovich Nikolaev, a former student at the St. Petersburg University, now at the Aleksandrovskaya penal facility at Irkutsk. The Council of the Division recommends that this request be granted after first inquiring of the prison administration whether the journal would be delivered to the inmate in question. The Division approves the Council's suggestion.

1911. Requests from the journals: "Conquest of the Air," "Events of the Week," "The Parish Priest," "Seedlings of Temperance," and "Fishing and Hunting" for exchange of publications and advertisements are declined.

1913. The journal is sent free to the Siberian Advanced Women's Courses, the Perm' City Community Library, and a students' club in the physicomathematical department of Yur'ev University.

The 11 March 1908 session of the Physics Division of the RPCS voted to establish a prize in the name of F. F. Petrushevskiĭ. In the words of the resolution: "The Prize is to be awarded for original research in physics that has been done in Russia and expounded in the Russian language. Preference is to be given to works by beginning physicists, and among these, to works of experimental nature." The first award of the prize (for 1909–1910) went to D. S. Rozhdestvenskiĭ, an assistant at the St. Petersburg University, with citations for: "the complete independence of the author, both in his selection of the topic and in his execution of the work; his having successfully overcome experimental difficulties to broaden substantially our knowledge in the area of anomalous dispersion; his subtle theoretical analysis of the experimental data."

Thus, we see that the works of Dmitriĭ Sergeevich Rozhdestvenskiĭ (1876–1940) on anomalous dispersion received recognition immediately; they were published in the JRPCS in 1910–1912 (42A, 87 (1910); 44A, 395 (1912)).

Anomalous dispersion in metal vapors had been the subject of numerous papers in the world literature, beginning with the first paper of F. Leroux, who had observed it in iodine vapor (1862). However, all of these studies were in fact merely qualitative because of the extraordinary experimental difficulties that were encountered. It had not been possible to obtain quantitative results—the dependence of the refractive index on wavelength—near the saturation line, i.e., there was no reliable experimental conformation for the dispersion theory.

Rozhdestvenskiĭ made the decisive advance, and the anomalous-dispersion formula was verified in his very first paper, Rozhdestvenskiĭ's method of obtaining the "hooks" was as follows. Light from an electric arc is passed through an interferometer and produces vertical white lines on the vertical slit of a spectrometer. A spectrum with horizontal interference fringes appears in the microscope ocular; the zero-path-difference central white band is strictly horizontal, while the higher-order fringes are inclined. If sodium vapor is introduced into one of the branches of the interferometer, the zero-order fringe will trace the dispersion curve with characteristic inflection points at the absorption line (anomalous dispersion). Near the absorption line, however, the bands merge and the most interesting range remains inaccessible to measurement. "It seems natural enough," Rozhdestvenskiĭ writes, "to offset the inclination of the fringes due to the small path difference introduced by the substance with anomalous dispersion by an inclination in the opposite direction due to a large path difference introduced by a substance with normal, i.e., comparatively small, dispersion. We place the first substance in one branch of the interferometer, and the second [a plane-parallel glass plate —Ed.] in the other. Where the path differences cancel one another, the slope of the fringes will be zero. It is at these points that the fringe ordinate will have the largest or smallest value and be situated on either side of the absorption line ... With a sufficiently large path difference and vapors of sufficient density, the maxima and minima are very sharp. The curves rise at an acute angle, and form a letter "V" where they change sign."

The superficial resemblance of the maxima and minima to hooks gave Rozhdestvenskiĭ's method its name. While earlier investigators had succeeded in approaching to within 16–20 Å of the absorption line, Rozhdestvenskiĭ had approached to 0.4 Å from its center, i.e., 40 to 50 times closer in one jump!

One of the most important triumphs of physical science in the late nineteenth century had been clear recognition of the fact that the nature of the solid state is in the province of physics. The Russian scientists E. S. Fedorov and Yu. V. Vul'f and the metallurgist D. K. Chernov had produced research of the first rank in this area.

Solid-state physics had a fervent propagandist in Prof. B. P. Veĭnberg, who headed the physics department of the Tomsk Institute of Technology (now the Polytechnic Institute) from 1909 through 1924, where the first serious physical research in that city was done under his supervision (it included geophysical research; he codified the work of more than 20 expeditions). He spoke in 1911 at the Second Mendeleev Conference (45B, 17 (1913)):

"It can be stated without exaggeration concerning solid-state physics that it is an impoverished and very slowly developing field ...

"Why is this so? ... Let certain physicists be informed without malice that the work of physicists, taken as a whole, has been and, indeed, always will be highly uneven, both in regard to the distribution of the effort over the entire front of the attack on nature for her concealed mysteries, but also in regard to the timing of the waves of this advance. This history of physics can be likened to a chessboard on which there are frequent periods when the king or queen and sometimes even pawns have plunged, without the support of other pieces, deep into the enemy's ranks, and there have been cases in which they have perished there or returned to their original places without any success.

"I mention an even more serious aberration: the headlong rush of a mass of physicists after Crookes in the search for the "luminous state of matter"—a movement whose dust settled quickly, so that soon there were only a few stragglers left on the field of battle, wandering about with no definite idea, with no plan for resuming the offensive, until the guiding stars α, β, and γ of the constellation Electron enthralled the next army of physicists ...

"In general, solid-state physics had never been fashionable or a conspicuous object of work on the part of physicists taken as a single whole. This unfashionable and obscure condition of solid-state physics has no doubt been one of the chief reasons for its slow development ...

"Those working in this field may take comfort in the thought that the Commander-in-Chief is not necessarily found in the vanguard, and may even be bringing up the rear; that the locomotive is not always placed at the head of a train; that a walking man may look as though he were being pulled forward by the leg whose extended foot is thrusting forward, while in fact he is being pushed by the leg that is behind at the particular moment; that the propellers of airplanes are sometimes placed in front and sometimes in the rear; or that the prow of a ship as it proudly shatters the waves is merely clearing a path for the rest of it, while the motive force is at the stern."

In 1912–1914, the journal published a series of papers by V. K. Arkad'ev (1884–1953), a student of Lebedev's, on the ferromagnetic properties of metals during rapid oscillations. In his paper on "The Reflection of Electric Waves from a Wire" (45A, 45 (1913)), Arkad'ev measured the energy reflected from several thin straight wires forming a small mesh; the distance between the wires was $\lambda/4$. The wavelength was determined from the maximum response of a receiving mirror as a function of the distance between the receiving rods of a resonator and also from the distance between the fringes of the interference pattern. The basic conclusions were as follows: 1) the magnetic properties of all of the ferromagnetic metals studied diminish with wavelength; 2) their magnetic properties tend to the vanishing point at a wavelength of about 1 cm.

The same volume of the JRPCS contained a brief note of Arkad'ev in which he summarized this and an earlier paper on the absorption of electric waves in parallel wires (45A, 103 (1913)). He constructs a general picture of the change in the magnetic properties of iron and nickel on the basis of his measurements and data of other authors. His diagrams, on which he plotted (in logarithmic coordinates) the magnetic permeability μ against the wavelength, give a clear picture of the magnetic-property variation with the number of magnetic-field reversals. After a small number of reversals, we have a range of constant permeability, and then we enter a range in which it decreases slowly (between 10^3 and 10^9 cycles per second); this is followed by a range of rapid decrease, in which μ drops to unity. In the thermal and optical regions, we again observe μ to be independent of the number of oscillations: $\mu = 1$.

For that time, Arkad'ev's investigations represented the first experimental studies to be carried out at an exceptionally high level. Although the experiments were made using damped electromagnetic oscillations and primitive techniques, they were confirmed (unlike many other later investigations) after almost 20–30 years, this time with the use of centimeter- and decimeter-wave sources (on magnetrons).

Finally, in a subsequent paper (45A, 312 (1913)), Arkad'ev constructed a theory of the electromagnetic field in a ferromagnetic metal.

He shows that the permeability calculated in the usual manner from the resistance of the wires to high-frequency current does not directly characterize the magnetic induction, and constructs a theory of the phenomena on the basis of Weber's molecular-magnet hypothesis. He showed that the observed phenomena can be described if Maxwell's equation is written in symmetrical form, introducing a complex magnetic permeability in analogy to the complex dielectric constant. Arkad'ev remarks in his conclusion that "The method that I have used here to represent the response of matter to the electric wave can be compared with the conventional device for representation of the variations of refractive index as a function of wavelength; just as this picture is sometimes referred to as the liquid's electrical spectrum in studies of the dispersion of liquids, so might the segment of the curve that I have studied be called the magnetic spectrum of the metal."

With the development of classical thermodynamics, the need to introduce statistical methods into physics—to apply probability theory—became increasingly evident. The investigations of Paul Ehrenfest and T. A. Afanas'eva-Ehrenfest occupy a prominent position in the work done in Russia on statistical physics. Ehrenfest was graduated in 1904 from the University of Vienna, where he wrote his thesis under Boltzmann. In the same year, he married a Russian girl, Tat'yana Alekseevna Afanas'eva, and moved with her to St. Petersburg.

Among the papers of P. S. Ehrenfest, we take note of the article "A Mechanical Theorem of Boltzmann and Its Relation to Quantum Theory" (46A, 58 (1914))—one of the papers devoted to the development of the author's "adiabatic hypothesis," which had an important part in the materialization of the early Bohr-Sommerfeld quantum theory. At that time, when the rules of quantization could be established only by "feel," by intuitive guesswork, the "adiabatic hypothesis" served as one of the first reliable guidelines in this direction. Relating the quantization rules to the so-called adiabatic invariants of classical mechanics, this hypothesis made it possible, for example, to generalize the already established rules to the case of an atom in an external field, thereby serving as a basis for the first quantum theory of the Zeeman effect. The adiabatic-invariant theory was developed further in the papers of Yu. A. Krutkov, who published an extensive investigation of this subject to the JRPCS in 1921 (50A, 83 (1921)).

P. S. Ehrenfest took an active part in the activity of the Physics Division of the RPCS and its journal. His by-line appeared very frequently in the pages of the journal over surveys and analyses of specific physical problems; he took an active part in the gatherings of physicists. In this connection, it is interesting to mention a polemic concerning the connotation of the term "physics" that developed in the pages of the JRPCS between Ehrenfest and Khvol'son (43B, 377–385 (1911)). Orest Danilovich Khvol'son (1852–1934), a professor of physics at St. Petersburg University and the author of the widely read "Textbook of Physics," appeared in the journal with an article entitled "What Is the Subject Matter of Physics?" He wrote:

"In Sec. 2 of my 'Textbook of Physics,' it is stated that "physics, in the broadest sense of the word, is the science of disorganized matter"...

"The above definition of physics embraces a long list of other sciences, namely: mechanics, chemistry, Astronomy, geophysics, mineralogy with crystallography, and geology. They have differentiated from "physics in the broadest sense" and are now independent sciences. Without this reservation, the definition given above of the subject matter of physics appears too broad, and could hardly be considered too narrow... An excellent article by P. S. Ehrenfest on the magneton appeared in this year's volume of the 'Problems of Physics' (Part B of the journal). Unfortunately, this article contains one passage on which I should like to comment... This passage reads: "But, to all appearances, we are now entering a time in which magnetic phenomena in ponderable matter will again occupy the attention of physicists; it appears that magnetism has now undergone a metamorphosis that has raised it from among the mere "phenomena of disorganized matter," which compose, if we are to believe Sec. 1 of any physics textbook, the subject matter of physics, to the level of real objects of genuine physical research.' The phrase 'if we are to believe' suggests that Ehrenfest regards my definition of the subject matter of physics as vulnerable to criticism. To the extreme distress and great discomfiture of his readers, Ehrenfest has sarcastically dismissed the definition given, if we are to believe him, by all physics textbooks without substituting his own definition, without troubling himself to assist readers who are suddenly left without any answer to the curious question: What is the subject matter of physics?"

Ehrenfest did not hesitate to answer:

"Professor Khvol'son interprets the lines that he cites an an implication that I know of some special definition of physics that I consider more satisfactory than the one with which Professor Khvol'son prefaces his physics textbook. This is a misunderstanding. I find myself obliged to submit the following explanatory remarks. (My reasoning is based on experience that I gained not as a teacher, but exclusively as a scientist.) With them, I hope to correct this fundamental misunderstanding and, at the same time, respond to Professor Khvol'son's related remarks.

"I have always recommended and propose now that the question as to the value of a given definition of the 'problems of physics' be resolved only if appreciable use has been made of this definition. I do not know of a single definition that has ever been applied...

"I have always recommended and propose now that in the interests of instruction in the intermediate school all definitions of physics known to me be denounced as noxious or, at the very least, dangerous. (I see danger in the possibility that the student may not see the abyss between the definitions of such concepts as "physics" and the definitions used to introduce the notions of the 'day,' 'density,' 'pressure,' and 'gram,'—that he may transfer to the definitions the easy-going attitude that he may naturally acquire regarding definitions of the former type if he recognizes that he will never need them)...

"The jextaposition of 'various definitions of physics,' as they appear in the textbooks of various periods, might perhaps aid indirectly in illuminating the historical development of this field of investigation that we call physics."

No major and serious physical question, not a single event in the physical world escaped the attention of the RPCS, and all of this is, of course, reflected in the pages of its journal. Nor could problems of public education fail to become a concern of the Physical Society. As early as 1908, the Physics Division of the RPCS selected a special commission from among its membership: the Pedagogical Commission. Its first act was to organize meetings of physics and chemistry instructors, for which it made preparations during the 1913—1914 New Year's Holiday. As the journal notes: "This event should be recorded as one of extreme importance in the history of instruction in the physical sciences. The foundation has been laid for a monumental task: to promote, through meetings of physical-science teachers, progress in instruction in physics, chemistry, and cosmography [a course that included a brief outline of astronomy—Ed.] in Russia. The expansion of exact scientific knowledge cannot but be reflected in the teaching of subjects related to it. The objectives themselves must be broadened, and teaching methods and the content of the courses must be changed. Left entirely to his own resources, the physics instructor is hardly in a position to follow the development of his subject and its methods" (46B, 195 (1914)).

A questionnaire was circulated among the teachers in preparation for the Congress. The results gave little comfort: only 40% of the educational institutions gave laboratory assignments, and only 69% of the physics instructors listed physics as their specialty. The trade schools were best off, and the most deplorable situation prevailed in the women's secondary schools: only 3% of them had a room for laboratory work, and 67% had no physics division. The question was therefore raised at the Congress concerning the need to hold periodic courses for instructors and to prepare specialized instructors for physics, chemistry and cosmography.

Professor N. A. Umov addressed the members of the Congress. "We see no unity or universal applicability of established doctrine in diplomacy, politics, the law, philosophy, or religion. Nor do we find an objective ethics. The natural historians stand before a straight and impartial judge—nature herself. In his experiments and measurements in the midst of a wealth of living phenomena, he passes through a great school of truth in judgment and action. To bring the minds and feelings of youth into contact with this field, which is exceptional for its inexhaustible vitality, purity, and creativity, this is the high cultrual mission of the instructor in the physical sciences."

Yet another painful problem was brought up at the conference—that of instruments. But it was stated most forcefully a bit later, at a session of the Society on 14 October 1914 to which Khvol'son delivered a speech "On the Manufacture of Physical Instruments in Russia:" "...on a problem that is no longer ripe, but overripe and even rotten. The great war now convulsing all of Europe must shake off many a heavy yoke. In include here the yoke of foreign industry, under which we have thus far been chafing... It remained for the war to open our eyes to our pathetic dependence on foreign industry; which we sense in thousands of trivia, having in many ways suddenly found ourselves bound hand and foot ... This includes the problem of manufacturing physical instruments for the secondary schools ...

"During this great struggle, everyone must strive with all his strength and resources to remove the obstacles on the path of our Motherland toward a bright future. A great renewed Russia must stand firmly on her own legs and strive to become as independent as possible of foreign industry. The genius of the Russian people, who threw off the yoke of the Tatars and the even more oppressive yoke of alcohol, and who emerged victorious from the Troubled Ages and from the First Patriotic War, will now know how to deal with the difficulties encroaching from all sides. And we must strive to help to the best of our ability, each in the field in which he lives and works."

It should be remembered that the First World War was underway at this time. It naturally found reflection in the activity of the Physical Society. On 9 February 1916, D. S. Rozhdestvenskiĭ reported that "because of the increase in the cost of materials and labor, the cost of publishing the journal will increase in 1916. At the same time, the paper shortage has obliged us to content ourselves with a lower grade and to print the journal on yellower paper." The First World War exacerbated the contradictions in the capitalist system and hastened and contributed to the revolution in Russia. The Great October Socialist Revolution, which resulted in radical reform of society and production relationships, opened a new epoch in the development of physics in Russia.

THE JRPCS AFTER THE OCTOBER REVOLUTION

The first few years after the victory of the October Revolution were years during which a new political order took form, years of construction of the world's first socialist state, years which passed under the conditions of a civil war and foreign intervention and the difficult conditions of rebirth of the country's economy. Needless to say, all of this found reflection in the work of the Society and its journal.

The following appears on the first page of Volume 50 (1918) of the JRPCS:

"The Editorial Committee of the Physics Section of the Journal of the Russian Physicochemical Society considers it its duty to advise its readers that publication of the Journal in spite of the sharp rise in printing costs has been made possible, both at the end of the year past and this year, only thanks to the concern of the directors of the Commissariat of Public Education, which has released 40,000 rubles of its funds to support publication in response to a request from Prof. O. D. Khvol'son, Chairman of the Physics Division. We consider it our duty to extend our heartfelt thanks to the Commissariat in the person of Comrade National Commissar for Instruction Z. G. Grinberg of the Northern Region Council of Communes and to Division Chairman Prof. O. D. Khvol'son for making it possible to continue publication of the Journal."

On 25 March 1919, the Chairman of a meeting of the Physics Division communicated "a proposal of the Council to increase the price of the journal to 5 times the price during previous years for nonmembers of the Division, since otherwise the Division's journal will be bought up as waste paper. Proposal accepted."

At this time, N. N. Georgievskiĭ, D. A. Gol'dgammer, A. F. Ioffe, P. P. Lazarev, N. D. Papaleksi, S. I. Pokrovskiĭ, and K. S. Rozhdestvenskiĭ made up the editorial committee of the journal. M. A. Gezekhus was its editor from 1911 through 1919. In 1919, the post of editor was taken over by Nikolaĭ Nikolaevich Georgievskiĭ (1872–1928), a metrologist of the Main Bureau of Weights and Measures, who had previously been employed in the physics department of the Institute of Technology. His best-known work was the one carried out jointly with N. G. Egorov in 1897 on the Zeeman effect. Egorov and Georgievskiĭ's experiments showed that the rays emitted from a flame or spark placed in a magnetic field are observed to be partially polarized—the oscillations parallel to the magnetic lines of force are attenuated.

A Congress of Physicists was convened at Petrograd in the bitter year of 1919. In his address to the Congress, A. N. Kaĭgorodov, a representative of the Commissariat for Public Instruction, noted that: "The success of the new order hinges on progress in the exact sciences. By organizing labor, science makes it possible to direct labor along the path of the greatest productivity. Thus, the first task of the renewed order is to support and develop the exact sciences. The problems of science, which are neither metaphysical nor self-sufficient, cannot differ from the problems of life as a whole...."

A resolution of the Congress of Physicists makes the following statement:

"The Congress recognizes the desirability of unifying Russian physicists into a common association with the purpose of providing easier conditions for scientific work, simplifying communication among scientists, and contributing to the unity of scientific publication work and expanding it. The association's center should be the Physics Division of the Russian Physicochemical Society ..."

The following resolution was adopted in regard to the publication of the physical literature:

"The Congress sees a need for augmentation of publication activity in physics by all possible means, and therefore charges the newly formed association with the following tasks: 1) development of a plan for a series of original and translated textbooks and monographs and arrangements for their publication; 2) making certain that the editing of the association's journal, like that of the Journal of the Physics Division of the RPCS, is of the quality due it. The journal must be able to accomodate all Russian literature on physics, both in the form of original articles and in the form of reprints of works that have appeared in other publications; monographs and all major works submitted by the Russian universities are to be printed in the form of special attachments. Papers that appear in the journal should, at the discretion of the editor, be translated into French; these translations could be issued for sale and subscription separately from the Russian text.

"Viewing the present total disruption of communications with foreign science as mortal to Russian science, the Congress has appointed V. A. Anri, A. F. Ioffe, A. N. Krylov and P. P. Lazarev as a special commission to find measures that will quickly open the way to acquisition of foreign scientific literature, the printing of articles by Russian authors in foreign journals, familiarization of foreign scientific circles with work being done in Russia, and procurement of scientific apparatus from abroad. In particular, it must be petitioned that permission, however exceptional in the present state of affairs, be given the scientific institutions to communicate by mail or otherwise with foreign countries on scientific matters and to send their representatives to such countries to purchase the necessary books and instruments and establish on-the-spot communications."

The Russian Association of Physicists created by resolution of the Congress did not, however, develop further. All problems in the organization of scientific research gradually came to be concentrated in the Academy of Sciences.

The 1920's began badly for the journal. The Editors were obliged to have the journal published in Berlin, and there was even a short interruption in its publication in 1923; finally, beginning in 1924, the JRPCS resumed publication under the Main Administration of Scientific Institutions (Glavnauka). It was no longer necessary to worry about how publication of the journal would be financed and where it would be printed—all this was taken care of by the State. A. F. Ioffe became editor of the journal. In the first issue of the journal for 1924, the Editors published the following statements: "This first issue presents older papers that have accumulated in the Editors' portfolio during recent years, some of them from the unpublished last issue of the preceding volume. The issues that follow will contain only more or less fresh material" (66, 1 (1924)). Resumption of regular publication of the Physics Section of the JRPCS as the "only organ in the Republic that unifies the works of Russian physicists" (56, 43 (1924)) was also welcomed in that year by the Fourth All-Union Congress of Physicists.

We should note that back in 1918, some of the functions of the JRPCS—namely, its review functions—had been vested in the newly organized journal "Uspekhi Fizicheskikh Nauk" (Advances in the Physical Sciences) (whose editor, E. V. Shpol'skiĭ, has held his post since its inception, right up to the present day); this journal replaced the second part of the journal (the "Problems of Physics"), which was also published as separate issues. Accordingly, an annotation to the 1924 JRPCS took note of the fact that "Only original articles of scientific nature on problems of experimental and theoretical physics will be placed in this journal."

In 1924, the journal published A. A. Fridman's remarkable work "On the Curvature of Space" (56, 59 (1924)), which the editors received on 1 July 1922. The history of this discovery is familiar, and requires no more than brief mention here.

As we know, Einstein was the first to apply his general theory of relativity to the cosmological problem—the problem of the properties of the universe as a whole. However, after having demonstrated the new possibilities that had opened here, Einstein began his search for the corresponding solutions of his gravitation equations from the tacitly adopted obvious hypothesis that the properties of the universe as a whole remain stationary in time; this conviction even forced him to introduce an additional "cosmological term" into the equations even though its existence did not follow from the logical foundations of the theory and it was needed only to obtain a stationary solution. It was to this stationary-state condition that Fridman took exception. He showed that the gravitation equations (even without the "cosmological term") have solutions that describe a time-varying model of the Universe, Out of this came one of the most fantastic predictions in the history of science—that of the expanding Universe and the flying apart of galaxies. This prediction was brilliantly confirmed in 1929 by the American astronomer Hubble.

At first, Einstein rejected Fridman's results, considering them to be in error. In 1923, Yu. A. Krutkov interrupted a trip abroad at Fridman's request to visit Einstein in Berlin, and soon after their discussion Einstein's note was published to acknowledge his error and offer high praise for the results of Fridman's work.

The new scientific institutes that had been created in 1918 had already taken form and were gaining strength by this time; the young Soviet science was actively engaged in the development of pressing physical problems. In 1924, the journal published a paper by Ya. I. Frenkel' on "The Theory of the Electrical Conductivity of Metals" (56, 505 (1924)). Written with the purpose of resolving the difficulties of explaining the electrical conductivity of metals in classical terms, this paper represented one of the first attempts to introduce quantum notions, which led to the development of the single-electron approximation—the basis of the band theory of solids. D. V. Skobel'tsyn's paper on investigation of the Compton scattering of γ rays in the Wilson cloud chamber dates from the same period (56, 120 (1924)). Using rather hard γ radiation from radium, Skobel'tsyn increased the scale of the phenomenon and was able to show that the results of the observations can be explained by the hypothesis of a "recoil" experienced by the electron as a result of scattering of one photon, in accordance with the conclusions of the Debye and Compton theory.

Interesting spectroscopic investigations were carried out during this period in the State Optical Institute, which was headed by D. S. Rozhdestvenskiĭ. Let us first briefly examine the works of A. N. Terenin, which date from this time, as we know, the ultimate purpose of spectroscopic investigation of the atom consists in the establishment of a system of terms, i.e., its energy-level scheme. This level scheme can be verified in a direct experiment by exciting the atom to a certain higher state and establishing the downward transitions that follow. The excitation itself can be accomplished either by electron impact or optically, if the atoms are made to absorb photons of a strictly definite frequency. Terenin made extensive use of the second, optical method of excitation. Thus, in his study of "The Optical Excitation of Atoms and Molecules" (58, 115 (1926)), this method was used to study the energy-level schemes of the antimony and arsenic atoms. In the same study, Terenin investigated the optical excitation of NaI vapor. When a gelatine film, which absorbs all lines shorter than 2500 Å, was placed on the path of the exciting light, the emission, which consisted of the visible region of the D line of sodium, vanished completely. Terenin interpreted this phenomenon as follows: "On absorption of light at a wavelength shorter than 2450 Å, the NaI molecule is placed in an excited state that soon decays under the action of collisions. The absorbed store of energy is then subjected to a certain redistribution within the molecule: some of it goes into dissociation of the molecule, some of it into excitation of the Na atom, and the rest may be transferred to thermal motion.'' This method—study of the optical excitation of molecules—has been highly productive in study of the decay mechanism of molecules and, in particular, of the elementary photochemical event, because it enables us to establish the state in which the decay products are released.

One of the most outstanding discoveries of Soviet scientists—the discovery of Raman scattering of light by L. I. Mandel'shtam and G. S. Landsberg—occurred in 1928. Mandel'shtam had become interested in the problems of light scattering much earlier, at the beginning of the 1920's, in connection with fluctuation phenomena. He arrived at the conclusion that in light scattered by thermal fluctuations in a homogeneous body that is totally free of foreign impurities, the spectrum contains not only a line with the frequency of the incident light, but also two symmetrically shifted lines, although their shift is small (58, 381 (1926)). This effect, in which the fine structure of the spectrum changes on fluctuation scattering, later came to be known as the Mandel'shtam-Brillouin effect.

In 1925, Mandel'shtam moved to Moscow, where he became Director of the University's Theoretical Physics Department, Landsberg, who had undertaken to detect Mandel'shtam's predicted effect in quartz, became one of his colleagues. It was first necessary to find a good crystal, so that scattering would be nothing other than molecular, and not due basically to crystalline defects. It was therefore decided first to establish the nature of the scattered spectrum. Measurements were made on an ordinary prism spectrograph, with the quartz illuminated by a mercury lamp. The result was unexpected—satellites appeared around each line, and at much greater distances from it than would follow from the theory. The positions of the satellites recurred regularly around each line.

Mandel'shtam understood at once that this was the same effect, but on the optical rather than the acoustic branch. It was only because of Mandel'shtam's exceptional inherent self-discipline, which held him back from publishing new observations until they had been repeatedly verified over a long time, that the discovery that he had actually been the first to make—together with Landsberg—appeared in print after Raman, who had observed this effect in liquids, had communicated his discovery by telegraph to ''Nature.''

Mandel'shtam and Landsberg were bothered primarily by the question as to whether the lines might not be a random reflection of the entire spectral pattern. The following experiment produced convincing proof that such superposition of spectra was impossible. A vessel containing mercury vapor, which absorbed the 2536 Å resonance lines, was placed between the scattering crystal and the spectrograph slit, but the satellites persisted on the photographic plate, i.e., it was shown that they have other wavelengths.

A preliminary report on the observation of the new effect—Raman scattering of light—appeared in the JRPCS in 1928 (60, 335 (1928)). In their discussion of the results, Mandel'shtam and Landsberg wrote: ''When the light is scattered, the natural infrared oscillations of quartz can be excited by the energy of the scattered quantum. The frequency of the scattered quantum should then be lowered by the value of the infrared quantum corresponding to the natural oscillations of the crystal.'' The wavelength values calculated in this way for the satellites that appeared agreed closely with the observations. It is interesting to note that this discovery was recognized as an outstanding one even in 1929, by E. Rutherford in his presidential address to the Royal Society.

The discovery of Raman scattering was the stimulus for an enormous number of papers. The method of experimental determination of the natural frequencies of molecular vibrations that was based on Raman scattering opened tremendous possibilities for physics, physical chemistry, and even organic and inorganic chemistry.

The development of the magnetron method of producing nondamping oscillations in the decimeter and centimeter bands by A. A. Slutskin and D. S. Shteĭnberg (58, 395 (1926)) played a major part in the advance of radiospectroscopy into the microwave band and in other scientific and technical work. In a study of the oscillations of electrons in an amplifier tube placed in a magnetic field, Slutskin and Shteĭnberg observed oscillations of extremely high intensity (wavelengths on the order of a few tens of cm) between the cathode and grid when the magnetic field was axial. The values that they obtained for the critical magnetic field (that at which oscillations at the particular wavelength cease) was in qualitative agreement with the estimates based on analysis of the motion of an electron in crossed electric and magnetic fields.

Many new areas of physics that were later extensively developed originated within the walls of the Leningrad Physicotechnical Institute formed after the Revolution, which was headed by A. F. Ioffe. One of these trends is found in N. N. Semenov's investigations of the kinetics of chemical chain reactions. We mention two of his papers, which were printed in the JRPCS in 1926–1928. In the first, ''On Certain Chemical Reactions'' (58, 329 (1926)), he deals with three surprising experimentally observed facts:

1) Currents of sulfur and cadmium vapor issuing under heating from the two side branches of a cold (liquid-air-cooled) test tube condensed on the latter's walls. First the sulfur was heated, and it coated the surface of the test tube with a thin deposit after a short time. Then the cadmium was heated, and an oval-shaped dark spot—a mixture of cadmium with sulfur—appeared opposite the mouth of the side branch. After a certain time, the deposit vanished instantly in the middle of this spot, and about a minute after the first ''explosion,'' i.e., explosive combination of the Cd and S to form CdS, there was a second, this time over the surface of a ring 2–3 mm wide encircling the position of the first explosion and bordering upon it. Then another ring exploded, and so forth. It was found that the thermal conductivity and heat capacity of the surface played an important role in this process (the explosions did not occur on a metallic base).

2) Oxygen does not combine at all with phosphorus vapor at low pressures. However, if the pressure is raised above a certain critical value, the reaction begins to advance at a very high rate and continues until the oxygen pressure has falled back to the critical level. If, after the phosphorus has been cooled with liquid air, the vessel is filled with oxygen under a pressure of a few hundredths of a millimeter of mercury, subsequent heating of the phosphorus to room temperature causes the vapor liberated to combine with the

oxygen in a series of successive explosions, with rapid pulsation of the light.

3) For all practical purposes, nonexcited mercury vapor does not combine with oxygen at temperatures below 200°C. However, the reaction begins under illumination by the resonance line from a quartz mercury arc, and the oxygen pressure in the flask decreases to one-tenth in 2 hours. The reaction rate first increases rapidly with increasing oxygen pressure, reaches a maximum, and then declines again. The existence of the rate maximum indicates that the reaction mechanism is not simple collisions of the excited mercury atoms with oxygen molecules.

These observations, together with other experiments, led Semenov to construct a theory of the kinetics of chemical reactions (60, 533 (1928)). The first cause of activation of the molecules in chemical reactions is the collision of two rather fast particles that have energies greater than or equal to an activation energy. However, Semenov drew attention to the fact that, in addition to this primary activation, there must be a secondary activation in any chemical process, one that chemical kinetics had not previously taken into account in general form. This is because any elementary process involves release of energy. Immediately after a reaction event, the reaction products possess an energy equal to the sum of the heat of the reaction and the heat of activation. Whether this energy is present in the form of excitation energy of the reaction products or in the form of kinetic energy of these products, the presence of high-energy particles makes a new activation easier at the point where the elementary reaction took place. This secondary-activation effect is observed with particular clarity in chain reactions, which acquire explosive character under certin conditions.

In the late 1920's, the JRPCS published a series of interesting papers by I. I. Lukirskiĭ on the physics of x-rays and the photoeffect in pure metals. The first paper in this series was entitled "Soft X-Rays" (57, 458 (1925)). The region of the spectrum in the interval from 10 to 150 Å is, as we know, very difficult to investigate; at the same time, the characteristic radiation of a number of light elements falls into precisely this region of the spectrum, and direct measurements of the corresponding wavelengths were not available at that time. The author was confronted with the task of developing a new measurement method. Lukirskiĭ proposed that the wavelengths of the x-rays be determined with Einstein's equation from the total energies of the photoelectrons knocked out of a metallic electrode by the radiation under study. If the irradiated electrode has the form of a minute sphere placed at the center of a large collector sphere, we should expect a sharp drop in the measured photocurrent as a function of the applied potential difference at the value of the stopping potential, which corresponds very excactly to the maximum energy of the emitted electrons. Thus, use of the spherical condenser transformed the stopping-potential method into one of the most accurate means of obtaining the total energies of the photoelectrons. Two of Lukirskiĭ's later papers (59, 133 (1927); 61, 81 (1929)) are concerned with the energies of Compton recoil electrons emitted at various angles to the direction of the primary pencil of rays; he demonstrated the existence of polarization of the x-rays in Compton scattering. It is noteworthy that British investigators (who had apparently remained unaware of these works) reported the polarization phenomenon in Compton scattering only in 1942. An extensive investigation of the normal photoelectric effect with a series of pure metals was performed by Lukirskiĭ jointly with S. S. Prilezhaev (58, 319 (1926); 60, 111 (1928)). All of the advantages of the spherical-condenser method are again demonstrated fully in this investigation, and the high measurement accuracy attained made it possible to subject Einstein's equation for the photoeffect to rigorous quantitative verification.

Another trend that developed at the Leningrad Physicotechnical Institute is associated with the name of I. V. Kurchatov. Here we refer to the discovery of ferroelectricity, which he made together with P. P. Kobeko in 1930. The fact that Rochelle-salt crystals have an anomalously large dielectric constant was known long before this work was done. Returning to this problem, Kobeko and Kurchatov made it their task to "clarify the role of polarization phenomena in the anomalously large value of the normal magnetic induction and, in addition, to obtain a single-valued electrical characteristic of the material" (62, 251 (1930)). For this purpose, Kobeko and Kurchatov investigated the dielectric constant as a function of field strength in plates of various thicknesses. The results indicated that everything depends on the field, and not on the thickness of the plates. Since they could not explain the observed phenomena in terms of high-voltage polarization, the authors analyzed in succession three possible causes of the increase in normal magnetic induction: 1) displacement of electrons in the atoms; 2) polarization oscillations of ions in the lattice; 3) orientation of molecules with a dipole moment. The first possibility was rejected immediately, because the refractive index of Rochelle salt has the normal value for solids and there is no reason to assume anomalously large electron displacements in the lattice of the salt. The temperature dependence of the effect makes it impossible to explain the data in terms of polarization fluctuations of the lattice. Thus, only the orientation effect of dipoles already existing in the crystal remains for treatment of the observed phenomena. Later measurements made under Kurchatov's supervision made it possible to affirm the presence of an internal orientation field in the crystal, an analog of the Weiss field for ferromagnetics, which explains the strong dependence on the dielectric constant on temperature and the existence of the second Curie point. All of the observed properties of Rochelle salt indicated spontaneous polarization.

The year 1930 was the last year of the existence of the JRPCS. As we have noted, there was no longer any need for a Physical Society; all problems of organizational nature were handled by the Academy of Sciences. A new stage in the development of physics had begun.

THE JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS

With the reorganization of the scientific societies and institutes that was carried out around 1930, the Physicochemical Society ceased to exist. With the termination of the Society's activity, its journal was also naturally discontinued. In 1931, the "Journal of Experimental and Theoretical Physics" (JETP) made its appearance as the successor to the Physical Section of the JRPCS. The first volume of the new journal (which was sent out to the subscribers of the Physics section of the JRPCS) bore the names of two responsible editors—Abram Fedorovich Ioffe and Leonid Isaakovich Mandel'shtam—on its cover page.

The "Journal of Technical Physics" was formed simultaneously with the JETP in 1930 by merging the "Journal of Applied Physics" and the journal "Physics and Industry," which had been appearing for several years prior to that date.

Much of the work of Soviet physicists continued to be published in Germany in the "Zeitschrift fur Physik." By the beginning of the 1930's, the output of Soviet physicists had grown to the point where it came to occupy 25 to 30% of the volume of this journal. At the same time, papers written by Soviet scientists in Russian were seldom consulted, with the result that the problem of priority had become acute. Soviet physicists then began to publish two of their own journals in foreign languages: the "Physikalische Zeitschrift der Sowjetunion" (beginning in 1932 at Khar'kov) and the "Technical Physics of the USSR" beginning in 1934 at Leningrad. These journals concentrated more than 90% of all the work done in the Soviet Union.

To some degree, the appearance of several physics journals (especially those published in foreign languages) had its effect on the publications in the JETP. However, the JETP remained first in physics among all the journals in Russian; many articles published in foreign languages were duplicated. The number of articles published increased very rapidly, and since most of them are known to the modern reader, we shall confine ourselves to a brief enumeration of some of the most important ones.

In the early 1930's, V. A. Fock developed an approximate solution of the Schrödinger equation for many bodies—the method of the self-consistent field (Hartree-Fock method). In this method, the motion of the electrons is regarded as a motion in the field of the nucleus and an averaged field created by the remaining electrons. On the basis of this method, V. A. Fock and M. I. Petrashen' solved the problem of the sodium atom numerically. The values found for the ground term and the ionization potential came to within 2% of the experimental values (4, 295 (1934)).

The investigations of A. A. Andronov in the theory of nonlinear oscillations and, in particular, the paper by A. A. Andronov and A. G. Lyubina "Application of Poincare's Theory of the 'Bifurcation Point' and the 'Reversal of Stability' to Elementary Self-Oscillatory Systems" (5, 296 (1935)) pertain to this same period. The phenomena of the appearance, disappearance and cutoff of the oscillations, which are highly important for physics, found an adequate explanation in the language singular points, limiting cycles, and the bifurcation values of the parameter.

In a study of the mechanism of conversion of light into heat in monatomic solid crystalline dielectrics in 1936, Ya. I. Frenkel' introduced the notion of the "exciton"—an elementary electrically neutral excitation associated with the formation of the electron-hole pair in semiconductors and dielectrics (6, 647 (1936)).

In the latter half of the 1930's, the JETP published many of the widely known works of L. D. Landau. He examined the theory of second-order phase transitions from a general thermodynamic standpoint and showed that such transitions occur on a change in lattice symmetry (7, 19, 627 (1937)). In his paper "Toward a Theory of Superconductivity" (7, 371 (1937)), Landau showed that a superconductor breaks up into a large number of alternating superconductive and nonsuperconductive layers in an intermediate state. Somewhat later, A. I. Shal'nikov observed experimentally that a semiconductor does indeed break up into a series of zones about 0.1 mm thick in the intermediate state.

In 1936, Landau published his paper (7, 203 (1936)) in which he established the form of the collision integral for a gas with Coulomb interaction between its particles. In 1938, A. A. Vlasov introduced a method for description of collective precesses in a plasma that was based on introduction of a self-consistent electromagnetic field into the kinetic equation (8, 291, (1938)). Together with Landau's later paper (16, 574 (1946)) in which he predicted the phenomenon of collisionless absorption of oscillation energy ("Landau damping"), these papers form the basis of modern plasma theory.

In 1940, K. A. Petrzhak and G. N. Flerov observed spontaneous fission of uranium nuclei (10, 1013 (1940)), and in the same year, in one of their papers on the kinetics of chain decay, Ya. B. Zel'dovich and Yu. B. Khariton showed that slight enrichment of the natural mixture of uranium isotopes with the light isotope U^{235} would make possible a chain process in which ordinary water could be used as a moderator (10, 29 (1940)).

In 1941, P. L. Kapitza's articles on the mechanism of heat transfer and superfluidity of helium II (11, 1, 581 (1941)) and Landau's on the theory of superfluidity (11, 592 (1941)) made their appearance.

The peaceful constructive labors of the Soviet people were interrupted on 22 June 1941 by the treacherous incursion of German armies into our country. Nevertheless, the JETP continued to appear regularly until September of 1941. In the winter of 1941–42, the Academy of Sciences and many of the Moscow and Leningrad institutes were transferred to Kazan', where publication of JETP was resumed in 1942. An editorial article was printed in the journal on the twenty-fifth anniversary of the Soviet State:

"Our country is observing the twenty-fifth anniversary of the Soviet State locked in mortal combat with Fascism, the most malevolent energy of mankind. Our Motherland and our people have been forced to suffer all of the hardships of single combat with the strongest and most highly perfected of any of the machines for the destruction of humanity that have ever existed. Using the many years of experience and the traditions of the piratic German military school, using all of the power of German industry and, wherever possible, the industry of occupied countries, using unbridled demagogic agitation and unleashing the darkest and basest instincts inherent to mankind, and, finally, taking advantage of the absence of a military threat in the West, Hitler has hurled against the young Soviet Union thousands of airplanes, tens of thousands of tanks, and millions of two-legged humanoids seized with a thirst for murder, rape, and pillage ...

"In listing the achievements of Soviet physics, we may not omit brief mention of the material and cultural base on which it rests ... An exceptional amount of attention has been devoted to physics literature. Each year, about a hundred, and sometimes more than a hundred books are published on various problems of physics. Together with the publication of monographs by Soviet authors, the best books of foreign authors have been translated systematically. A network of physics journals composing more than 400 printer's signatures per year has been created.

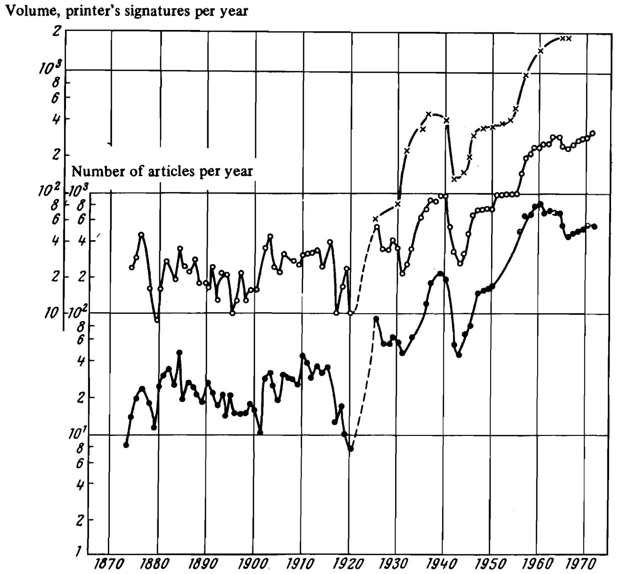
"And even during this war, physics is contributing its mite to the defense of our country. Professor Kobzarev's instruments detect enemy aircraft at great distances, and those of Prof. Aleksandrov protect our ships from being hit by enemy shellfire. The powerful optical systems on our warships enable them to destroy enemy fortifications and ships tens of kilometers distant.

"Soviet physicists are doing their duty during the years of war with the bloodthirsty fascist beast. There must not be a minute of rest until the energy has been reduced to ruin. All the strength of the mind, all of the many years of habituation to the struggle with the forces of nature must be mobilized to aid the heroic Red Army in the noble task of crushing the enemies of free-thinking humanity."

The Academy of Sciences returned to Moscow in the spring of 1943, and with it went the editorial staff of JETP. The editor of the journal during this period was Sergeĭ Ivanovich Vavilov (who had replaced A. F. Ioffe and L. I. Mandel'shtam in this post in 1939). From 1952 through 1956, after Vavilov's death, the journal was edited by Nikolaĭ Nikolaevich Andreev, a specialist in acoustics, and the position was assumed in 1956 by Petr Leonidovich Kapitza.

Many new specialized physics journals began to appear in our country in the middle 1950's: "Crystallography" (1956), "Instruments and Experimental Technique" (1956), "Radiophysics" (1958), "Optics and Spectroscopy" (1956), "The Physics of Metals and Metallography" (1955), "Solid-State Physics" (1959), "Nuclear Physics" (1965), "Theoretical and Mathematical Physics" (1969), "Semiconductor Physics and Techniques" (1967), and others.

Naturally, the appearance of these journals also had its effect on the character of JETP. The journal ceased to be a nearly exclusive outlet for publication of "everything in all of physics," definitely an unrealistic objective for any journal at the present volume of scientific publication. Instead, the journal is now called upon to serve as an organ that would unify all areas of the physical sciences. It was to publish papers of the most general physical interest, while works of more specialized nature would be submitted to the appropriate specialized journals. Experience had shown that the need for such a journal with coverage of all fields of physics did in fact continue to exist, despite the tendency toward narrow specialization that is observed both in physics and in other sciences. The JETP can by no means be said to suffer a shortage of papers offered for publication or, for that matter, of readers, and the same apparently applies to foreign journals of similar nature.



The present rapid rate of scientific development requires corresponding speed in the publication of new scientific results obtained by investigators. To delay their publication would be roughly equivalent to delaying the distribution of industrial products needed by the national economy because suitable packaging was not available. The attainment of the shortest possible publication schedule is therefore an important objective for any scientific journal. The lead time for JETP is now 5—6 months (provided, of course, that it does not become necessary for the authors to revise the article). This period includes both editorial processing and preparation of the manuscript and the entire process of typesetting, proofreading, and printing of the journal. It is apparently impossible to shorten it further with existing printing methods.

With this and timeliness requirements in mind, the decision was taken in 1965 to publish the semimonthly "JETP Letters" as a supplement to the main journal. Like other publications of this type in the international scientific literature, this journal is to provide a means for timely publication of brief reports on the most interesting new results in all areas of experimental and theoretical physics. A simplified printing process and strict limits on the volume of the reports has made it possible to reduce the publication lead time to 1—1½ months in this journal.

In summarizing the hundred years of the journal's history, we present data that illustrate the quantitative aspect of its development. These data have been plotted as curves that indicate (in logarithmic coordinates) the total annual journal volume in signatures (upper curve with open circles) and the numbers of articles published per year (lower curve with dark circles). The same plot shows the volume growth of the USSR's physics periodicals in general (upper curve with crosses). Prior to 1917, both the number of articles and the total volume remained at practically the same level, but under the Soviet regime, the volume of publications has increased by a factor of about 10 (and the number of articles by approximately 20 times). It is interesting to note the rather clear correlation between the deep valleys on the curves and the political events of 1905 and the two wars that our country has survived.

Over the past 10 years, the volume of JETP has remained almost constant; strict screening of the articles by the editors has been of no small importance here (the rejection percentage has reached 40—45). But the total volume of all periodical literature continues to increase, and hence so do the difficulties of really using it in the interest of the development of science.

This process, needless to say, cannot be allowed to continue indefinitely; problems of adjusting the flow of scientific information that appears in print to the requirements of science will inevitably arise, and it will be necessary to find a solution for it. But this is another subject entirely.

Translated by R. W. Bowers
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[1] Here and below, only the volume number and section, the page, and the year are given in references to JRPCS and JETP. Issues of the JRPCS were divided into two sections with separate numeration of the pages. The first section (A) contained original papers and the minutes of the Society's meetings. The second section (B) contained review papers, abstracts of foreign works, book reviews, etc.