Soviet Physicists awarded stipends by the Rockefeller Foundation

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The First World War severely disrupted industry and agriculture in Russia, as well as all institutions of its social and cultural life. Science, including physics, was also isolated from the outside world. This was also true of other countries involved in the world war, Germany, England, France, Austria, Poland, etc., but they were affected to a lesser degree. The difficult situation in Russia was exacerbated by civil war and a blockade which isolated the country from the outside world for more than two years. During this time the country found itself in a deepening economic crisis. The Soviet government was aware of conditions, and despite the severity of the situation in the Soviet Republic and the lack of funds, the government made allocations from its own gold fund in the very first post-revolutionary years for the development of new physical institutes. These institutes were organized in 1918. Allocations were also made for foreign travel, so that the institutes' prominent staff members could reestablish contacts with western scientists, and purchase instruments, reagents, books, and journals. In 1920–1921, representatives of the older generation of physicists, V. A. Anri, A. F. Ioffe, A. N. Krylov, P. P. Lazerev, M. I. Nemenov, D. S. Rozhdestvenskiĭ, and O. D. Khvol'son traveled abroad, mainly to Germany, but also to Holland and England. Some younger scientists who had recently graduated from the University of Moscow and the University of Petersburg, A. A. Arkhangel'skiĭ, P. L. Kapitsa, Yu. A. Krutkov, and V. M. Chulanovskiĭ, also traveled abroad.

In the mid 1920s Soviet physicists, mathematicians, and engineers began to participate in international conferences. In 1924, P. S. Ehrenfest from Leyden participated in the Ninth Congress of Russian Physicists in Leningrad. Ehrenfest had been closely linked with physics in Russia since the beginning of the century. In 1925, Leningrad and Moscow celebrated the 200th anniversary of the Russian Academy of Sciences. More than 100 scientists from all over the world were invited to the anniversary session. One of the guests was Max Planck. In following years, up until the mid 1930s, prominent physicists of England, Germany, France, and the US came to the Congresses of Russian Physicists (1926, 1928, 1930), as well as conferences on theoretical physics (1929, 1934), nuclear physics (1933, 1937), and made prolonged visits, primarily to the Leningrad and Kharkov Physicotechnical Institutes.

In 1925, another important channel of international communication opened up for Soviet science, in the form of prolonged visits abroad by Soviet physicists and mathematicians (as well as astronomers and biologists). These trips were subsidized by the international Rockefeller Foundation. Its founder, John D. Rockefeller, Sr. (1839–1937), was the patriarch of an American dynasty of industrialists and financiers. At the beginning of the century he allocated a substantial fund for the development of education and science. In 1901 these funds were used to open the Rockefeller Institute for Medical Research, which later became Rockefeller University, one of the largest universities in the US.[1]

In May 1913 the Rockefeller Foundation was created, and its goal was proclaimed to be "to contribute to the flourishing of humanity throughout the world."

In the late 1920s the Rockefeller Foundation subsidized the visits of a number of Soviet physicists and mathematicians abroad for a period of about a year. These scientists are named below in Table I. During 1924–1938, that is, the active period of the Rockefeller Foundation, a total of 645 scientists from 37 countries of the world received stipends, including 116 scientists from the US, 83 from Germany, 37 from Poland, 33 from Hungary, 30 from England, 27 from Austria, 25 from Holland, and 21 from France. Russian science was represented by 33 scientists, 23 of them citizens of the USSR, the remainder "first wave" emigrants. Among them was one of the representatives of a famous astronomical dynasty, Otto Struve (1897–1963). He emigrated from Russia in 1920, worked and became famous in the US, and was a member of the American National Academy of Sciences.

The peak of Rockefeller Foundation activity occurred in 1924–1928, when about one third of the 427 stipends were given to physicists, one third to biologists, and the remainder divided between chemists and representatives of agricultural science.[1)]

The Rockefeller Foundation not only provided for the travel of young scientists, but also financially supported institutes (for example, the Bohr Institute in Copenhagen and the Kamerlingh–Onnes Low Temperature Laboratory in Leyden). It also paid for visits to various universities and science centers of the world by widely-known scientists to give lectures and supervise the work of young scientists. Yet another bit of "financial" information: in 1924–1938 the Rockefeller Foundation spent 18.4 million dollars; 1 million of this figure went to pay for the stipends of young scientists.

The main staff members of the Rockefeller Foundation who determined the awarding of stipends during the period we are examining were the following:

Wycliffe Rose, President of the Rockefeller Foundation from 1923 to 1928, a philosopher and historian by profession. His contacts with the Rockefeller Foundation began in 1910.

August Trowbridge, director of the scientific division of

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TABLE I. Soviet physicists and mathematicians-recipients of Rockefeller Foundation Stipends.[4]

Name, Date of Birth and Death	Profession	Place of Work at Time of Rockefeller Foundation Stipend Award	Date of Award	Length of Rockefeller Foundation Stipend	Scientific Title at Life's End
Aleksandrov, Pavel Sergeevich (1896–1982)	Mathematician	Moscow State University	August 1922	8 months	Academician, USSR Academy of Sciences
Bezikovich, Abram Samoĭlovich (1891–1970)	Mathematician	Leningrad State University	November 1924	9 months	Fellow of the Royal Society (England)
Davidovich, Pavel Yakovlevich (1899–?)	Mathematician	Astrophysical Institute (Leningrad)	November 1924	12 months	Fellow of the Royal Society (England)
Frenkel', Yakov Il'ich (1894–1952)	Physicist	Leningrad Physicotechnical Institute	May 1925	12 months	Corresponding Member, USSR Academy of Sciences
Goncharov, Vasiliĭ Leonidovich (1896–1955)	Mathematician	Geodesic Institute (Khar'kov)	May 1926	12 months	Corresponding Member, USSR Academy of Pedagogical Sciences
Orelkin, Boris Petrovich (1884–?)	Physicist	Leningrad Polytechnical Institute	June 1926	12 months	Corresponding Member, USSR Academy of Pedagogical Sciences
Krutkov, Yuriĭ Aleksandrovich (1890–1952)	Physicist	Leningrad State University/ Leningrad Physicotechnical Institute	July 1926	12 months	Corresponding Member, USSR Academy of Sciences
Men'shov, Dmitriĭ Evgen'evich (1892–1989)	Mathematician	Moscow State University	September 1926	12 months	Corresponding Member, USSR Academy of Sciences
Luzin, Nikolaĭ Nikolaevich (1883–1950)	Mathematician	Moscow State University	September 1926	12 months	Academician, USSR Academy of Sciences
Fok, Vladimir Aleksandrovich (1898–1974)	Physicist	Leningrad State University	August 1927	12 months	Academician, USSR Academy of Sciences
Sinel'nikov, Kirill Dmitrievich (1901–1966)	Physicist	Leningrad Physicotechnical Institute	December 1928	24 months	Academician, Ukrainian SSR Academy of Sciences
Skobel'tsyn, Dmitriĭ Vladimirovich (1892–1990)	Physicist	Leningrad Polytechnical Institute/Leningrad Physicotechnical Institute	December 1928	24 months	Academician,USSR Academy of Sciences
Gamov [Gamow], Georgiĭ Antonovich (1904–1968)	Physicist	Leningrad Physicotechnical Institute/Main Astronomical Observatory	January 1929	12 months	Corresponding Member, USSR Academy of Sciences
Bari, Nina Karlovna (1901–1961)	Mathematician	Moscow State University	January 1929	9 months	Professor
Landau, Lev Davidovich (1908–1968)	Physicist	Leningrad Physicotechnical Institute	1930	12 months	Academician, USSR Academy of Sciences

the Rockefeller Foundation in Europe from 1924 to 1928. He was a physicist.

Wilbur Tysdale, assistant to the director of the scientific division of the Rockefeller Foundation in Europe (1926–1929). Later he became the deputy director of the entire Rockefeller Foundation and remained at this post until 1938.

Febius Levin, American biochemist.

At first, the directors of the Rockefeller Foundation were not in a position to make contacts with Soviet Russia. The situation changed considerably when Dr. Rose became the director of the Rockefeller Foundation. He recommended that substantial sums of money be given, in principle, to Soviet physicists for subscriptions to journals (3500 dollars). About 20,000 dollars was to be provided for the purchase of books.[2] However, this proposal was probably not supported, as the monies were not transferred to the representatives of the USSR. However, the very fact of this initiative is significant. It is interesting to note that in allocating funds for foreign travel of young scientists, the Rockefeller Foundation stressed that they had to return to their country, since the goal of this organization was to support national scientific personnel. To substantiate the desirability of providing a Rockefeller Foundation stipend to V. A. Fok and I. E. Tamm, Trowbridge wrote the following in a letter dated 25 October 1926 to Rose: "There is no doubt that if these candidates receive a stipend, they will return at the end of the period to Leningrad and Moscow and will again take the post of docents."[2),3]

Below is a table listing the names of Soviet physicists and mathematicians who received Rockefeller Foundation stipends. Their names are listed in order by the date they received the Rockefeller Foundation stipend.

Let us now briefly comment on this list. The first thing that one notices is that virtually all the mathematicians (Aleksandrov, Bari, Men'shov) are from the Moscow school of N. N. Luzin. As for the physicists, almost all are students or associates of A. F. Ioffe, representatives of the Leningrad physics school, the school of the Leningrad Physicotechnical Institute. Yu. A. Krutkov and his student, V. A. Fok, are usually associated with Leningrad University, but it should be noted that both of them worked at the Leningrad Physicotechnical Institute for a long time. It is clear that virtually all of the young scientists who received Rockefeller Foundation stipends became famous scientists. It was easy to obtain some brief biographical information about them; it was sufficient to turn to encyclopedias or special references. There were only two exceptions, B. P. Orelkin and P. Ya. Davidovich. Boris Petrovich Orelkin was not a physicist, he was a crystallographer (crystal chemist). In his scientific career in Petersburg-Leningrad he was associated with E. S. Fedorov, whose courses he attended at the Petersburg Mining Institute. He studied the problems of crystal chemical analysis, which in the "pre-X-ray" period (that is, before the works of M. von Laue, V. Friedrich, P. Knipping, Bragg, father and son, and Yu. V. Vulf) was the most fruitful in the study of crystal lattices. Orelkin's work was valued in Russia and abroad. The candidacy of Orelkin to receive a Rockefeller Foundation stipend was advanced by Bragg (Sr.), and supported by Yu. V. Vulf. During the period of his award he worked at the Faraday Research Laboratory of the Royal Institution in England. On his return to Leningrad he worked at polytechnical and chemical-technological institutes.

P. Ya. Davidovich was also erroneously indicated in the Rockefeller Foundation documents as a mathematician. He was an astronomer who began his work at the Tashkent Observatory. In 1921 he was invited to Petrograd, where he became a member of the committee to organize the Main Russian Astrophysical Observatory. In 1923, the Moscow State Astrophysical Institute was created on the basis of the committee, and Davidovich began to work at this institute. He studied the problems of the photometry and spectroscopy of novae and nebulae. He received a Rockefeller Foundation stipend on the recommendation of Harlow Shapley, and spent a year with him at the Harvard University Observatory. In 1928, while he was in the US, he fell ill and was taken to a clinic for the mentally ill. His condition did not improve and, according to a statement of the US government, he was sent home. There his illness progressed, and he died in 1931.[3)]

For completeness we note that among the Rockefeller Foundation stipend recipients were young Soviet biologists who became member-correspondents of the USSR Academy of Sciences: the neurohistologist B. I. Lavrent'ev (1892–1944), the cytophysiologist D. N. Nasonov (1896–1957), professor and cytologist M. S. Navashin (1896–1973), and the cytogeneticist G. D. Karpechenko (1899–1942). They all became great scientists widely known both in the Soviet Union and abroad.

The age of the majority of the Rockefeller Foundation stipend recipients is about 30 years, but N. N. Luzin is the exception to this rule. He received a Rockefeller Foundation stipend intended for professors. This same stipend was given that same year to Professor B. P. Gerasimovich (1889–1937) as well, who later became the director of the Pulkovo Observatory. He visited the US (again, Shapley) for several months.

The question of awarding A. F. Ioffe a stipend of this type was brought before the directors of the Rockefeller Foundation by P. S. Ehrenfest, and the first document from the archives of this foundation which we present is associated with this proposal. Pavel Sigizmundovich Ehrenfest, as we will see, took direct and interested participation in the destiny of all Soviet candidates for a Rockefeller Foundation stipend in physics. We would like to dedicate the following short section of the article to this outstanding man and scientist.

P. S. Ehrenfest. A great deal of material has been published on Pavel Sigizmundovich Ehrenfest in the USSR, some of it in Usp. Fiz. Nauk (Sov. Phys. Usp.)[5,6] His extremely good relationship with Soviet physics and its representatives was also expressed in his assistance in obtaining Rockefeller Foundation stipends. Ehrenfest met most of the physicists who received Rockefeller Foundation stipends and are listed in the table during his first visit to the USSR after the revolution in September 1924. This was at the time of the Fourth Congress of Russian Physicists, and these young people presented reports at the congress. Ehrenfest got to know them through Ioffe, whom he had known since 1906. In 1907 Ehrenfest married the Russian mathematician Tat'yana Alekseevna Afanas'eva. He came to Petersburg and lived there for about 5 years. As soon as he arrived he organized a club on the new physics. This club met every

FIG. 1. Beginning of the 1920s. Left to right: D. S. Rozhdestvenskiĭ, P. S. Ehrenfest, A. F. Ioffe.

week in his apartment. Among the participants in the seminar club were representatives of the middle generation of Russian physicists, A. F. Ioffe, V. F. Mitkevich, D. S. Rozhdestvenskiĭ, and young physicists such as Yu. A. Krutkov, a student of Ehrenfest.

Ehrenfest was not only a highly educated and talented theoretical physicist who had made a significant contribution to the quantum theory of radiation, statistical physics, and later to the application of quantum mechanics to the problems of the physics of solids and atomic nuclei. He was deeply interested in experiments and even conducted work in Leningrad (in the fall of 1924) with Ioffe on the acoustic emission of charged crystals. Although this work remained unpublished for some reason, it was well known among physicists studying the mechanical properties of crystals at the Physicotechnical Institute (N. N. Davidenkov, M. V. Klassen-Neklyudova). Ehrenfest was well informed on all the major studies conducted in the 1920s at the Physicotechnical Institute, including, of course, those conducted by Ioffe and his close associates. These issues were actively discussed in the correspondence between the two scientists.[7] He had a very high opinion of the scientific and organizational talents of Ioffe, and his first contacts with the Rockefeller Foundation, in any case, to the extent to which they involved Soviet physicists, involved Ioffe in 1924. By that time Ioffe was the director of the Physicotechnical Institute, dean of the Physics and Mechanics Faculty of the Polytechnical Institute, and a full member of the Russian Academy of Sciences. One of the goals of the Rockefeller Foundation was to support full-fledged physicists. The foundation sought to create the most favorable conditions for work and the possibility for contact with scientists (primarily young scientists just starting out) abroad. One should examine the letter regarding Ioffe sent by Ehrenfest to Professor Robert Millikan. Ehrenfest had chosen to write Millikan for at least two reasons. First, Millikan knew well and regarded highly the work of Ioffe on the statistical nature of the photoeffect and the method of determining the elementary electric charge. Second, the American physicist was very famous (in 1923 he became a Nobel laureate in physics for his classic work on the determination of the charge of the electron), and the Rockefeller Foundation could not ignore his opinion.

"17 December 1924, Leyden

"Dear Professor Millikan,

"Permit me to write you in German, since my scant English has again evaporated [in 1923 Ehrenfest was in the US for a long time-V. F.]; the remainder is a thin monomolecular layer which cannot cover the surface of the pages of my letter. Like all my letters to you, this one also contains a request. I would like to ask for your assistance regarding my friend Professor A. F. Ioffe from Petrograd. It would mean a lot to him and to his many students (one of them, P. L. Kapitsa, is now in Cambridge) to have the opportunity to spend 1–2 months in the United States, to visit a few laboratories there and to meet representatives of the younger and older generations of physicists to discuss their research. I was in Russia from 1 August to 1 October, and spent virtually all of this time in laboratories. I had the opportunity to contact many of Ioffe's students. Many of them are quite young and poor, and work with amazing and fascinating enthusiasm. Frequently they are compelled to interrupt their work for one or two weeks to take on the hard physical labor of stevedores or manual laborers to earn money to continue their studies (additional difficulties arise for those who suffer from tuberculosis). In the course of my two-month stay in Russia, I again had the opportunity to see what excellent lads these are, who must work so hard, to see how great is their desire to learn and understand. And I came to the conclusion that it is extremely important for the future of these young people to have several Russian researchers and teachers who, despite difficult economic conditions and the difficulties of moral order, continue to dedicate their life to science, although they are at the brink of exhaustion. Thus, it is of great importance for the future of young scientists in Russia, no matter what happens in the realm of politics, to have the opportunity of support for scientific instructors, to provide some rest for them, and to support the publication of the results of their research abroad. On the other hand, it is

important to provide a counterflow of science into Russia from beyond the borders. In this situation personal contacts mean a great deal, especially when one considers the present situation in Russia. Ioffe has a lot to talk about: over 30 papers from his laboratory have been published in Z. Phys. in the last year and a half. Please help Ioffe to come to the US for 1-2 months in the spring of 1925 and to visit several physics laboratories. I have heard from Professor Lorentz that at the last Solway Congress Ioffe made a great impression. Bridgman and Hall participated in the congress, and so they know Ioffe. Doctor Levin from the Rockefeller Institute is acquainted with the laboratories of Professor Ioffe and his associates. Since he knows Russia very well and understands the psychological climate of this country, he can evaluate the role which Ioffe plays in the future of young scientists in Russia.

"Doctor Levin told me that several famous American physicists have already taken the initiative to invite Ioffe. He hopes he will be able to acquire the funding needed to obtain a steamer ticket. In any case, he supports the plan for this trip. In April of last year I held preliminary talks with Langmuir and Heymans (from the Technological Institute in Boston) about this. Both of them sincerely support this idea. But here is why I have doubts about whether I should write him myself. It seems to me that you can evaluate the situation much better than I. That is why I decided to address my request only to you, in the hope that you would gather what help is possible for Ioffe to come to the US. Langmuir, Heymans, more than likely, Bridgman and Hall, and certainly Levin will also do all that depends on them. It is necessary for Ioffe to get the opportunity to visit a number of laboratories [Ioffe's visit to the US took place in 1926–1927–V. F.].

"It is astonishing to see how fruitfully he examines any physics experiment which is being prepared. In addition to everything else he has an exceptional critical talent. More than once I had the opportunity to witness the unexpected and astounding effect that his comments had on famous researchers, and with what ease he deflected erroneous attacks on his own works; he was not a student of Roentgen for nothing! (This will again be demonstrated in his comments on the research of Professors Meier and Polanyi, as well as Ewald, which will be published in Z. Phys. [34(11–12), 889 (1925)–V. F.]) Of course it is a shame that he has no opportunity to pay for the cost of a trip to the US at the expense of his country, but at the present time this is absolutely impossible. Naturally he is very interested in seeing your laboratory and your associates. But I fear that this will be impossible due to the large expenses associated with such a trip. You may be the better judge of this than I.

"Ioffe has no intent of involving himself with politics and propaganda. He is a superb lecturer who knows how to present problems and methods to his listeners, how to sketch them in the most significant manner. Students regard him highly. Of course, he knows English well and speaks much better than at the time of our meeting on board the steamer from Cherbourg to Bremen.

"P. Ehrenfest"[2]

Ioffe's trip to US took place in 1926–1927. He spent several months in California at the famous California Institute of Technology, and in Boston at the Massachusetts Institute of Technology. Among the American scientists, Ioffe made especially close contacts with Millikan, L. Loeb, the physical chemist G. Lewis, and the electrical engineer V. Bush.

One of the results of the trip was a series of lectures given at Caltech on the physics of crystals. This series was published in a book in Russian and English.[8]

Soviet Physicists Awarded Stipends by the Rockefeller Foundation. Candidates for a stipend from the Rockefeller Foundation[4)] had to complete a standard form which was not very different from today's personnel reports. The significant points in this form were the plans for research during work under the Rockefeller Foundation stipend and the justification for the theme selected. Moreover, the candidate for a Rockefeller Foundation stipend had to indicate at what scientific center and with whom he wanted to work. The form was completed with the signatures of the candidate himself and two scientists, the one who proposed the candidate, and another supporting his candidacy. A list of the candidate's publications had to be attached to the application.

The most complete materials in the archives of the Rockefeller Foundation are for Ya. I. Frenkel' and K. D. Sinel'nikov. There is surprisingly little data on L. D. Landau.[5)]

The following sections are devoted to Soviet physicists who received Rockefeller Foundation stipends (they are given in chronological order by the date they received their stipend). The material, where possible, is given in the same form and is illustrated by documents from the archives of the Rockefeller Foundation and other archives.

Yakov Il'ich Frenkel' (1984–1952).[9,10] In 1913 Frenkel' entered the physics and mathematics department of Petrograd University. He graduated in 1916. He was a privatdocent at the Tavricheskiĭ (Crimean) University (1918–1920). In 1921 he became a staff member at the Physicotechnical Institute and a professor at the Polytechnical Institute in Leningrad. By 1925 he had completed a number of studies in theoretical physics. Of these we note the quantum theory of contact phenomena (in the framework of the Bohr theory), the quantum theory of metals, the theory of the crystal lattice, and classical electrodynamics. He was the author of several monographs (by 1925 he was the author of six books).

The candidacy of Frenkel' for a Rockefeller Foundation stipend was proposed by Ehrenfest. From the correspondence between Ehrenfest and Ioffe[6] and the letters of Frenkel'[9,10] one can trace the stages of the organizational efforts. On 8 April 1925 Trowbridge in Paris wrote Rose in New York:

"As regards my visit to Leyden, I discussed with Professor Ehrenfest the possible candidates for Rockefeller Foundation stipends among the physicists and mathematicians of Russia. You will remember that while Professor Ehrenfest is not Russian, he has spent many years in this country as an instructor.[6)] He has corresponded with his Russian colleagues during the war and revolution, and this correspondence continues to the present. With his help several young Russians have gotten the opportunity to travel abroad for a short time.[7)] I assume that Professor Ehrenfest has discussed with you during his visit to New York some of the most gifted young Russian scientists. Now he has nominated two of them: Yakov Frenkel' and Georgiĭ [Yuriĭ–the Authors] Krutkov. This letter concerns Yakov Frenkel', whom

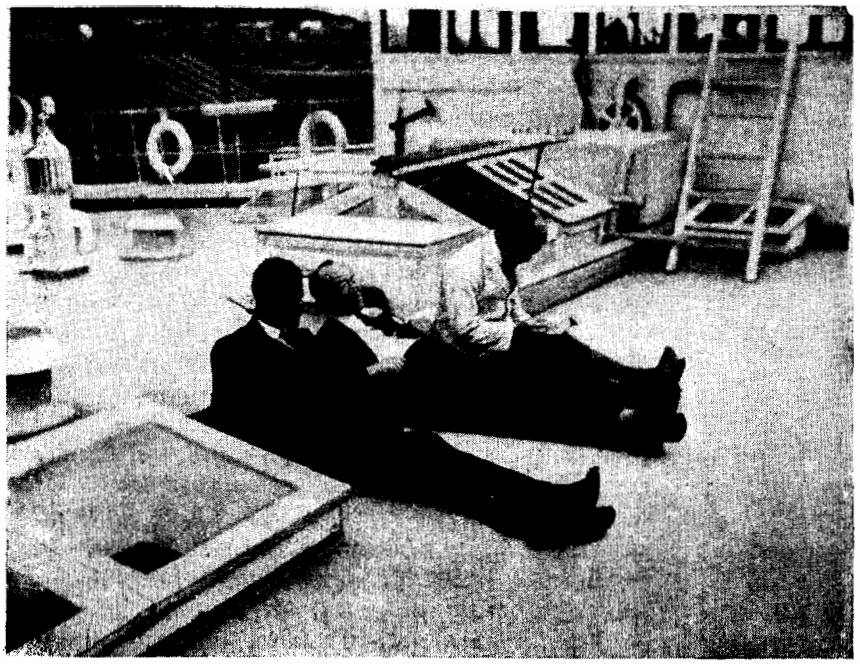

FIG. 2. At the Sixth Congress of Russian Physicists, August 1928. On the deck of steamer Alekseĭ Rykov chartered by the Association of Russian Physicists. Left to right: P. A. M. Dirac, Ya. I. Frenkel', A. Landé (Photograph from the collection of the Center for the History of Physics, New York).

he selected first ... The nomination [of Frenkel'] for a Rockefeller Foundation stipend is supported by Professor M. Born from Göttingen. Born made reference to Frenkel' in these words: 'He has demonstrated in his work a very high mastery of mathematical methods of physics and deep penetration into the physics of phenomena.'

Professor Ehrenfest says that, in his opinion, if one can assist Frenkel' and two other young people from Russia, it is the most significant thing that can be done at present for Russian science. As a result these people will return home with new ideas which they will develop during their year-long visit to the west. Professor Ehrenfest suggests that Frenkel' should begin his work in Göttingen with Born for three or four months, after which he may need to spend four or five months in England at Cambridge. Frenkel' hopes to begin his work in Göttingen in the fall of 1925.

FIG. 3. At the International Congress In Memory of A. Volta at Como, Italy in October 1927. Left to right: Ya. I. Frenkel', O. Stern, W. Pauli, P. Debye (From the collection *Memories of Pauli*).

As for the size of the stipend, I think that in this case we should consider the usual 185 dollars per month set for a married man."[11]

Rose answered Trowbridge on 20 April 1925, informing him that he supported the candidacy of Frenkel' and hoped that his candidacy would be confirmed at the administrative session of the Rockefeller Foundation.

In his application, in the portion about his research plans, Frenkel' indicated that he would like to work in the area of the theory of the liquid state. This work, which was begun in 1924, was the object of the next 20 years of his career, and was concluded in 1945 with the writing of the monograph *The Kinetic Theory of Liquids* (in German). His second area of research was classical electrodynamics. During his stay in Germany he completed the first volume of this monograph (a textbook), which was published in 1926 in Germany. The second volume was also published in Germany two years later (the Russian translation appeared in 1934–1935).[12]

In accordance with the plan indicated in the application, Frenkel' worked in Göttingen with Born and in Hamburg in a collaboration with Pauli and Stern. He was in France several times in 1925–1926 (collaborating with Brillouin, Langevin, and Curie), as well as England (Dirac and Fowler) and Belgium.

There are a number of documents in the archives of the Rockefeller Foundation on Frenkel' which illustrate the foundation's system of monitoring the work of its stipend recipients.

During Dr. Tysdale's visit to Göttingen, he met with Professor Courant and in a memorandum containing an account of this meeting he indicated, "According to Courant, the research of Frenkel' is extremely good."[11] When he was in Leyden on 13 October 1926, Tysdale met with Ehrenfest and sent the following report on Frenkel' to the Rockefeller Center:

"I saw Ehrenfest, the most pleasant of the scientists that I met in Europe. I spoke with him about the Rockefeller Foundation stipend recipients with whom he had been in contact, and of Frenkel' he said that the award of a stipend was correct, that he made good use of his time. Ehrenfest noted that it was amazing how many people he got to know and how many new results he was able to obtain in such a short time. He assured me that Frenkel' would return to Russia and that his choice as a stipend recipient was very worthwhile."[11]

Frenkel' returned to Leningrad in late fall 1926 and continued his work at the Leningrad Physicotechnical Institute and the Leningrad Polytechnical Institute. The details of his travel abroad in 1925–1926 can be learned from letters home from Germany, England, and France.[9,10]

Yurii Aleksandrovich Krutkov (1890–1952)[13,14]. In 1908 he entered the Physics and Mathematics Faculty of Petrograd University. He graduated in 1912. He was a student of Ehrenfest, and he completed his first studies on the quantum theory of radiation and adiabatic invariants under his direction. In 1913 he worked with Ehrenfest for several months in Leyden. In the first post-revolutionary years he worked simultaneously at the university and the closely associated State Optics Institute (Rozhdestvenskiĭ), in the Physicotechnical Institute and in the Physics and Mechanics Faculty of the Polytechnical Institute (Ioffe). In 1922–1923 he was on a long assignment in Germany and Holland. As early as 1920 the works of Krutkov were of great interest to Born, who wrote to Einstein that he had a high opinion of Krutkov's article on adiabatic invariants, and noted that "he must be an outstanding theoretician."[15]

Ehrenfest proposed that Krutkov receive a Rockefeller Foundation stipend, and noted in his letter of 6 August 1925 to Professor Trowbridge that for both Frenkel' and Krutkov it was "very important to draw up all the papers as soon as possible, as this procedure takes a long time in Russia."[7] During his visit to Caltech in the US, Ehrenfest asked Millikan to support the candidacy of Krutkov (and Frenkel'). Millikan carried out this request, noting that, based on his conversation with Ehrenfest, Krutkov was a theoretical

FIG. 4. Göttingen, spring of 1926. Left to right: Yu. A. Krutkov, Ya. I. Frenkel', S. I. Vavilov, M. Born, V. N. Kondrat'ev, P. Jordan, J. Franck, P. L. Kapitsa.

physicist with exceptional abilities, and stressing that the living conditions in Petrograd "at the present time are very grave, and are paralyzing Krutkov's creative activity ... if he could spend a year or two in Germany and then return to Russia, this would have a great effect on the useful career which he would develop in Russia."[7]

Krutkov wrote to Trowbridge:

"Berlin, 2 January 1926

"Dear Dr. Trowbridge:

"Please forgive my writing in German, as it is very difficult for me to write a long letter in English.

"You know from my previous letter that I have been delayed in Berlin (I am very sorry that you did not receive my letter from Russia). I have also informed Mr. Lund and Mr. Ehrenfest about this. Professor Born (Göttingen) is in America until the beginning of March. Thus, I have asked Ehrenfest whether I should immediately travel to Göttingen. He supposes that I could do this, but I have decided to remain in Berlin until 16–20 January for the following reasons:

"1) I would like to finish here one rather old problem on the small oscillations of a spherical pendulum. I corresponded with Planck on this problem when I was in Russia. The exposition of this problem in the majority of textbooks on mechanics is in error. I have already completed a nonelementary exposition [of this problem] and I shall try to find a simple derivation.

"2) I have prepared two articles here for publication: one on the mechanical bases of statistical physics (for Z. Phys.[16]), and another on the relativistic movement of a free material point, for which the Lagrangian equations are not suitable. This work is intended for a German mathematical journal, or could be a letter in the C. R. Acad. Sci.[17]

"I estimate that I will finish this work in about two weeks and will then travel to Göttingen. If I go directly there now, I fear that I will be unable to prepare this work due to the many new physics impressions.

"I would like to thank you for the stipend I have received (for 8–31 December 1925) and ask that the next money orders be sent to Berlin.

"I am very happy that now, thanks to the international Rockefeller Foundation, I have the opportunity to conduct scientific work in peaceful surroundings.

"With best wishes, yours truly,
"G. Krutkov"[7]

During his time in Germany Krutkov spent most of his time in Göttingen, although he also worked in Berlin, Hamburg, and Paris. The main papers of those mentioned in the letter above appeared somewhat later, in 1928 (about this time he was again in Göttingen, this time with both of his students, Fok and Gamov).

Krutkov was educated in the spirit of classical physics, and was able to participate to the fullest extent in the further development of physics in the framework of the quantum theory of Planck, Einstein, and Bohr, and carried out several important investigations in this field. However, he essentially made no contribution to the field of quantum mechanics, although he was a witness to its first steps during his Rockefeller Foundation stipend in 1925–1926. Instead, in subsequent years (from 1928 to 1936) he leaned more and more toward classical problems of statistical physics, the theory of brownian motion, and the theory of gyroscopes and its applications. From this point of view it must be acknowledged that 1925–1926 did not have a strong effect on his further studies, and this was reflected in a review of his work written in rather reserved tones which was compiled at the request of the administration of the Rockefeller Foundation.

FIG. 5. At the first All-Union Physics Congress in Odessa, August 1930. On the deck of the steamer Gruziya chartered by the congress. Left to right: W. Bothe, A. Sommerfeld, Yu. A. Krutkov.

At the very end of 1936 Krutkov was arrested. From the late thirties he had gotten the opportunity (in detention) to work at first in the field of mechanics in the design bureau of A. N. Tupolev. Then he was drawn by I. V. Kurchatov and A. I. Leĭpunskiĭ toward work on the uranium project (the theoretical foundations for the separation of isotopes and the design of accelerators. He received the State Prize with the German physicists G. Hertz and G. Barvich). In 1947 he was released from detention and resumed work at Leningrad State University as the head of the department of theoretical mechanics in the Faculty of Mechanics. In the last years of his life he studied problems in the theory of elasticity.

Vladimir Aleksandrovich Fok (1898–1974).[18] When he finished modern school [a non-classical secondary school] in 1916, Fok entered Petrograd University. He graduated in 1922 and was kept on to prepare for a professorial career. Like Krutkov, whose student he was, he was closely associated with Leningrad State University and the Vavilov Order of Lenin State Optical Institute, but he also worked at the Leningrad Physicotechnical Institute and in the Physics and Mechanics Faculty of the Polytechnical Institute. In 1927 he received a Rockefeller Foundation stipend on the

FIG. 6. Leningrad, 1933. Left to right: ?, I. V. Kurchatov, A. I. Alikhanov, V. A. Fok.

recommendation of Ehrenfest. He mainly worked with Born in Göttingen. By 1927 he had already become known and was recognized for his work in quantum theory (adiabatic invariants), theoretical optics, mathematics, mathematical physics, and quantum mechanics. Of the investigations he completed during the period of his Rockefeller assignment, we note his work in collaboration with Born in which the question of adiabatic invariants was examined in the framework of quantum mechanics.

The correspondence regarding Fok's candidacy for a Rockefeller Foundation stipend began in the fall of 1926. On 25 October of that year, Trowbridge wrote Rose from Paris[3] that Fok had been nominated for the stipend by Ehrenfest, and that this nomination was supported by Born, who indicated that he was ready and willing to accept the Soviet physicist for a year at his Institute of Theoretical Physics in Göttingen.[8)]

On 10 October 1926 Ehrenfest wrote Trowbridge from Leyden that he had just received the applications completed by Fok and Tamm and that he could not express a preference for one of the two extremely gifted candidates. Ehrenfest specially wrote the following: "I understand quite well that the Rockefeller Foundation, which has been so benevolent to the first Soviet candidates, would like to be able to choose from their number only first class candidates, since the foundation has received so many nominations. But I should say that some Russian mathematicians and persons in physics, for example, P. S. Aleksandrov, Bezikovich, and Frenkel', have received very high evaluations from English, German, Danish, and Dutch scientific circles,"[3] and so the choice made by the Rockefeller Foundation on Ehrenfest's recommendation can be considered justified.

Trowbridge wrote, based on Fok's statement, that Fok would work in "the same field as Professor Born, with whom he has expressed a desire to work if he receives a stipend. He has published nine articles in various journals, and Professor Born, who has examined these publications, confirms that he would be very happy to see him [Fok] in his laboratory [Institute–the Authors] and that, in his opinion, Fok's papers demonstrate his outstanding abilities."

Later in the letter, Ehrenfest's special interest in that a Rockefeller Foundation stipend be awarded to both Soviet theoreticians, Fok and Tamm, is made clear.

As a result, the Rockefeller Foundation stipend was awarded to Fok for one year at 172 dollars per month. Trowbridge's nomination of Fok was confirmed in the meeting of the Rockefeller Foundation administration in December 1927.

Tamm soon got the opportunity for a long assignment abroad (in Holland and Germany) through the Lorentz Foundation. He was the first Soviet recipient of a stipend from this Foundation.

Let us present, in conclusion, letters Fok wrote during his time abroad as a Rockefeller Foundation stipend recipient.[9)]

"Paris, 18 May 1928

"Dear Pavel Sigizmundovich [Ehrenfest],

"At the beginning of May I arrived in Paris, first to rest, and second to become acquainted with and speak with the physicists there. I attended two lectures of Langevin and spoke with him; I also visited De Broglie.

"At the beginning of June I shall return to Göttingen and continue work with Born.

"You wrote to me that in May and June Dirac would be at Leyden with you. I would like to see him to discuss with him my work on the solution to his statistical equation, and to find out his opinion. Moreover, I would especially like to speak with you about various questions in the theory of quanta. Could I stop by Leyden for a few days on my return trip to Göttingen? Write me to let me know if you approve of this plan. If so, I would ask you to provide a recommendation for me to receive a visa to Holland, if this is necessary. If no, then I will return directly to Göttingen.

"In April I wrote to Z. Phys. and sent two papers, one on the relation between the integrals of the equations of motion and the solution of Schrödinger's equation,[20] and the

second on Dirac's statistical equation.[21] I gave a copy of the manuscripts of these papers to Born before I left.

"I have not seen Trowbridge yet, but I want to visit him.

"Yours truly
"V. Fok"
"Paris, 24 May 1928

"Dear Pavel Sigizmundovich,

"Thank you very much for your letter of 20 May, and especially for your kind invitation. I only fear that you will be inconvenienced because I am not coming alone, but with my wife (the daughter of Lermantov, a laboratory assistant at Petersburg University, whom you apparently know). Perhaps it would be better to make arrangements for a hotel?

"I am eager to see you and speak to you, and I will leave as soon as I receive my Dutch visa. Yesterday I showed your letter at the Dutch consulate and submitted an application for a visa. They told me that they would make inquiries in Leyden, which would require several days. I expect to receive an answer on the 29th, and I will probably leave Paris on the 30th. I will telegraph you of my exact time of arrival in Leyden.

"In any case, I hope that you will still be in Leyden when I arrive.

"I was at the Rockefeller Bureau and spoke there with Tysdale. I did not get to see Trowbridge.

"I am very interested in speaking with Dirac.

"Best regards. Thank you very much for your concern for me.

"Yours truly,
"V. Fok"

In 1928 Fok returned to his homeland and resumed his work in Optical and Physicotechnical Institutes.

Kirill Dmitrievich Sinel'nikov (1901–1966).[22] In November 1920 Sinel'nikov entered the Physics and Mechanics Faculty of the Crimean (Tavricheskiĭ) University. He graduated in 1923. After this he worked in the Azerbaijan State University in Baku in the department of his teacher in Simferopol, Professor S. N. Usatyĭ. In 1924 he presented a paper on the electrical properties of dielectrics in Leningrad (at the Fourth Congress of Russian Physicists). The paper made a good impression on Ioffe, who proposed that Sinel'nikov move to Leningrad to work at the Leningrad Physicotechnical Institute. There he worked on problems in the physics of dielectrics. He conducted many studies with Kurchatov (with whom he had worked in Baku, and with whom he had studied earlier at the Crimean University).

Kapitsa became interested in Sinel'nikov's studies.

In 1928 Sinel'nikov was on an assignment financed by the Supreme Soviet of Economics. He was at Rutherford's laboratory in Cambridge. Apparently, by this time an agreement had already been reached with Kapitsa concerning his coming to work in the magnetic laboratory, which was headed by Kapitsa. Virtually as soon as Sinel'nikov arrived in England, negotiations began to award him a Rockefeller Foundation stipend. A large part in the successful resolution of this problem was played by Ioffe. Ioffe had become acquainted with the young physicist in Russia, and Rutherford nominated him for a Rockefeller Foundation stipend. The nomination was supported by Kapitsa.

Sinel'nikov's file in the Rockefeller Foundation archives is rather large, and includes several letters by Rutherford and Kapitsa and a short letter from Kurchatov. Portions of these letters are presented below. We begin with Rutherford's letter to Trowbridge, dated 19 May 1928.

"Dear Trowbridge,

"I assume that Professor Ioffe spoke with you about the nomination of a young Russian, Mister Sinel'nikov, with a request to support him before your Foundation so that he might have the opportunity to work at the Cavendish Laboratory. I have seen his publications and think that this is a promising scientist, an able scientist with original thoughts. I discussed this with Doctor Kapitsa, who knows Sinel'nikov, and we agreed that he would continue his studies in magnetism.

"I am prepared to support this nomination in any way possible because I feel that at present it is very desirable to

FIG. 7. Khar'kov, 1934. At the entrance of the Ukrainian Physicotechnical Institute. First row (left to right): L. V. Shubnikov, A. I. Leĭpunskiĭ, L. D. Landau, P. L. Kapitsa. Second row (left to right): B. N. Finkel'shteĭn, O. N. Trapeznikova, K. D. Sinel'nikov, Yu. N. Ryabinin.

assist as much as possible young scientists from Russia in cases where one can hope for the establishment of fruitful contacts with colleagues who are conducting studies in other countries.

"Yours truly,
"E. Rutherford"[23]

This letter from Rutherford was attached to another more official letter dated 24 August 1928. By that time Sinel'nikov was already in Cambridge and had begun his work there. Rutherford's letter ended as follows: "Considering the situation in Russia, I think that it is very important that the best young Russian physicists get the opportunity to join the work being conducted in other laboratories. It is not necessary that they conduct studies in the field which was the object of their work in the past."[23]

Apparently this is already a reference to the fact that in Cambridge Sinel'nikov was not only intending to work on the physics of solids, but also on problems in the physics of the nucleus (which is what he did when he returned to the USSR).

From other materials in the file, however, it is clear that the award of a Rockefeller Foundation stipend to Sinel'nikov met with some difficulties. Another letter was sent to Tysdale on 6 September 1928 from James Franck. In this letter the famous German physicist gave a high evaluation of the papers of his young Russian colleague. One can conclude from Franck's letter (apparently stimulated by Ioffe) that the doubts of the Rockefeller Foundation administration were associated with the relatively small number of publications (by 1928) by Sinel'nikov. Franck dispelled these doubts in his letter.[10]

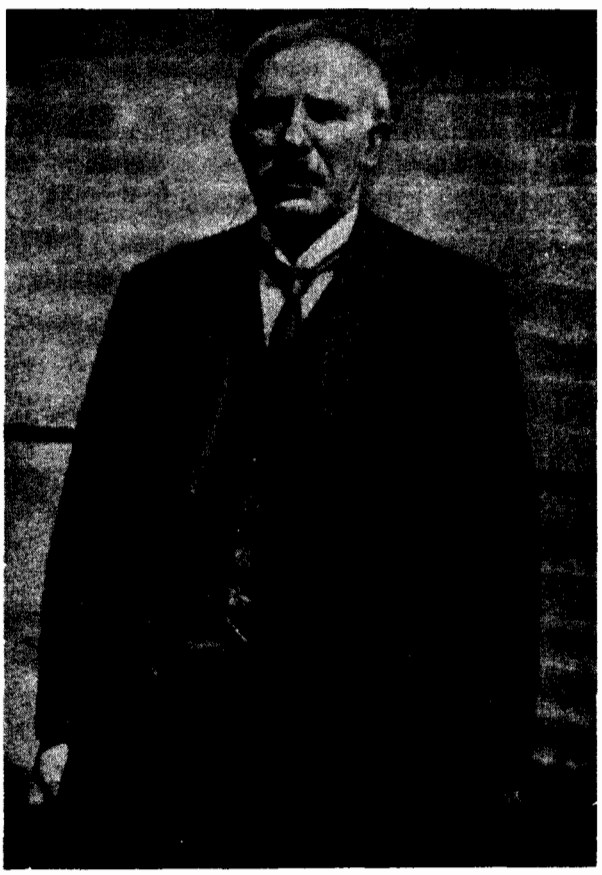

FIG. 8. E. Rutherford (1920s).

This goal was also pursued by a letter to the Rockefeller Foundation administration sent two days later from Leningrad by Kurchatov:

"Dear Sir,

"I am sending you copies of the works of Doctor Sinel'nikov, who indicated that the articles that he had sent earlier did not reach you. I would appreciate your confirmation of the receipt of this letter and the materials.

"Respectfully,
"I. Kurchatov"[23]

The following series of letters to the Rockefeller Foundation administration request an extension of the stipend for another year. This primarily refers to the communication by Sinel'nikov himself (dated 4 June 1929), which is supported by letters from Rutherford (7 June) and Kapitsa (7 June). Kapitsa writes the Rockefeller Foundation administration:

"Dear Sir,

"Mister Kirill Sinel'nikov, who is one of the stipend recipients of your foundation, and who is now conducting research at the Magnetic Laboratory, has turned to you with a request for an extension of his stipend for another year. I would like to support this request in any way possible.

"At present, Mister Sinel'nikov is developing a new method of measuring electric resistance in crystalline substances. The basic idea of this method is reduced to the use of induction currents which arise in crystals and the measurement of the dynamic effects that they generate. It is assumed that these effects are proportional to the surface conductivity. The importance of this method, which is completely new, lies in the fact that it makes it possible to measure the electric conductivity of small crystal samples. These measurements are not accompanied by deformation of the crystal lattice, that is, the generation of a side effect, which introduces errors in virtually all other methods in which contacts are used. These errors occur either due to solder or due to pressure (clamping). This method is very important, especially if one considers low temperature measurements (at the temperature of liquid nitrogen or helium), combined with the strong magnetic fields, which are now obtained in the laboratory.

"Mister Sinel'nikov has developed this method with complete success and at present he has shown in his research that there is no doubt that this method will work well, and one can now begin some preliminary measurements.

"Mister Sinel'nikov requires another year to complete his work, and it would be a pity if he did not have this opportunity. The great mastery and perfect command of the theoretical and experimental sides of the research work indicated above make it possible to consider Mister Sinel'nikov a very promising young scientist; there is no doubt that he deserves the support of your foundation.

"Respectfully,
P. Kapitsa"
"Deputy director of the Cavendish Laboratory,
"Fellow of the Royal Society"[23]

However, another letter from Rutherford was required (dated 24 June 1929) to obtain the Rockefeller Foundation stipend extension, since the administration of the Rockefeller Foundation was limited to issuing stipends for only one year, and made exceptions to this rule only in special cases.

This special case was realized, mainly due to the support of Rutherford and Kapitsa. In the last letter of those indicated, Rutherford stressed that Kharkov Physicotechnical Institute, at which Sinel'nikov was to work, would not be fully equipped by fall 1929, and thus he could not immediately continue his work there. Moreover, the forthcoming start-up of a factory to produce liquid hydrogen would provide Sinel'nikov with the unique opportunity to gain experience in working with liquid hydrogen.

"Finally," concluded Rutherford, "I am greatly impressed by Sinel'nikov, who seems to me to be a man of great abilities, who has a good command of the experimental art. Due to his insufficient knowledge of the English language and his shyness, Sinel'nikov has only in the last few months become acquainted with the laboratory staff and has gotten the opportunity to make full use of his time in Cambridge. Based on this, I am sure that it will not be a mistake to provide Sinel'nikov with a stipend for another year, and he will obtain much that is useful from his time in Cambridge and his acquaintance with new areas of research.

"Sincerely,
"E. Rutherford"[23]

In Sinel'nikov's record there is yet another, final, document drawn from the daily notes Tysdale made at Cambridge much later. On 21 June 1932 Doctor Tysdale writes:

"Kapitsa told me that the most outstanding scientists in Russia are the following seven persons:

"Ioffe, physicist, Leningrad

"Semenov, chemical physics, Leningrad

"Frenkel' (former stipend recipient), theoretical physics, Leningrad,

"Fok (former stipend recipient), theoretical physics, Leningrad,

"Mandel'shtamn, experimental physics, Moscow,

"Sinel'nikov (former stipend recipient), physics, now working in Kharkov,

"Gamov (former stipend recipient), theoretical physics, Leningrad,

"Bukharin, responsible for the development of science as a whole in Russia. Recently he visited Kapitsa for a rather long time, and I think that he [Kapitsa] discussed this list of scientists with him."[23]

Tysdale continued (this information, although not directly related to Rockefeller Foundation affairs, is of definite interest):

"It seems to me that Kapitsa has a very good relationship with the Russian authorities. He acquainted me with a letter from the ministry of Education which contained a proposal to provide [him] with one million rubles to organize an institute. Kapitsa would be the director, wherever [in any part of the country] and whenever Kapitsa felt it was necessary."[23]

In the materials which have been presented one notes the special interest of such great authorities as Rutherford and Kapitsa in Sinel'nikov's fate and his research. This conflicts somewhat with the scientific results obtained by Sinel'nikov during his time in England. In Ref. 22 (p. 36) it is indicated that there he developed "an electric motor which works in vacuum and attains 3000 rpm." The author of Ref. 22 notes that these studies were definitive in the development of an ultracentrifuge, evidently having in mind specifically that type of centrifuge (that is a nonturbine type). Although Ref. 22 presents a photograph of Sinel'nikov in a doctor's robe, it also indicates that he did not have time to defend his dissertation at Cambridge. In Proc. R. Soc. 1929–1930 and other publications one cannot find papers on the subject indicated in Kapitsa's letter.

However, there is no doubt that Sinel'nikov received excellent training in England which in many respects determined his later achievements in physics, which pertain already to the early 1930s (research on the artificial disintegration of nuclei) and subsequent studies on nuclear physics, accelerators, and plasma physics, as well as vacuum metallurgy.

Dmitriĭ Vladimirovich Skobel'tsyn (1982–1990).[24,11] In 1911 Skobel'tsyn entered the Physics and Mathematics Faculty of Petrograd University, and in 1915 he graduated. There he remained to prepare for a professorial career. In 1916 he began to work at the Polytechnical Institute, and from 1918 he was in close contact with the Physicotechnical Institute. Skobel'tsyn was on the staff of the Institute from 1925 to 1938, that is, before he moved to the Lebedev Physics Institute in Moscow. Skobel'tsyn was the first Soviet physicist to begin work on the atomic nucleus and cosmic rays. His research during his time abroad (1928) concerned the physics of γ rays and the Compton effect. These studies were

FIG. 9. D. V. Skobel'tsyn and F. Joliot-Curie, 1936.

successfully conducted mainly using a Wilson chamber in a magnetic field. These studies by Skobel'tsyn in the late 1920s became widely known not only in the USSR but also abroad. In 1928 they were highly regarded by Rutherford, who invited Skobel'tsyn to present a survey paper on the problems of β and γ rays at an international conference in Cambridge. Skobel'tsyn was abroad for a month (July–August 1928). Even before this time the question was raised of providing Skobel'tsyn with a Rockefeller Foundation stipend. It was discussed in the correspondence of Marie Curie and Ehrenfest, who had raised the question. On his recommendation, Mme. Curie became acquainted with the papers that Skobel'tsyn had published to that time. They made a favorable impression on her (as follows from Ehrenfest's letter dated 28 November 1927), and she expressed a willingness to invite the Soviet physicist to work in her laboratory. At the beginning of 1928, Ioffe became involved in this correspondence, and in the support of Skobel'tsyn. By this time the question of awarding Skobel'tsyn a year-long Rockefeller Foundation stipend had been brought before the board of the Rockefeller Foundation (by Trowbridge).

In the archives of Ehrenfest are letters from Skobel'tsyn. Of all the materials at our disposal, they are the most indicative of the role which Ehrenfest played in the awarding of Rockefeller Foundation stipends to Soviet physicists. Let us present these letters:[12]

"Paris, 14 July 1928

"Dear Pavel Sigizmundovich,

"I am very grateful for your postcard, which I received several days before I went abroad. I am sorry that this letter has been delayed. I did not answer you from Leningrad because I thought that if I wrote from abroad the letter would reach you sooner.

"I am mailing this letter from Paris, which I reached through Berlin. I was delayed in Berlin because it was necessary to obtain a French visa, and I had little free time there. Nonetheless, I did manage to go to Dahlem and speak with Meitner, whom I hope to see later in Cambridge. I will be in Cambridge by 23 July if there is no delay in obtaining my English visa. My itinerary from there has not been completely determined.

"Here I met a representative of the Rockefeller Institute who told me that the stipend question will be resolved in America no sooner than the end of September. This makes it difficult to carry out the proposed trip. Yesterday I met Madame Curie for the first time. Plans have been made to meet with her and Hollweck on Thursday, 20 July to discuss my research in more detail.

"Best regards, yours truly,
"D. Skobel'tsyn"
"29 July 1928

"Dear Pavel Sigizmundovich,

"I must again begin with apologies and explanations why this particular letter is late. Your letter, for which I am infinitely grateful, was received at the Inst. du Rad. after my negotiations there had ended. I did not receive this letter in Paris. It was brought by Joliot, who arrived for a conference in Cambridge and delivered it to me a day before my paper. Until the conference was over it was absolutely impossible for me to think about your proposal and answer you. Now, however, I can say with complete certainty that it is absolutely necessary for me to return to Russia in August and completely impossible to arrange my affairs so that I may remain abroad without interruption. There are a number of reasons for this, and it is necessary from a great variety of viewpoints.

"As for the difficulties of which I wrote, I specifically had in mind the possibility of timing the beginning of my work to coincide with the beginning of the school year. If the stipend is given only at the end of September, then it will be difficult for me to come to Paris before December.

"From further negotiations I found, however, that neither the Rockefeller Foundation representative nor Madame Curie oppose this postponement. From my point of view, shifting the beginning of work abroad is partly favorable because it gives me the oppportunity to finish what seems to me to be interesting observations which I have already begun. There are grave difficulties associated with the need to set up anew the entire experiment in conditions which are far from identical. From the point of view of the basic principle of scientific work, the economy of efforts and labor, the expediency of this undertaking seems doubtful, and is justified only in the case where the result would be some great achievements.

"As for your wish to provide me with the opportunity of discussing various questions associated with my research with prominent specialists, it should be said that the Cambridge conference provided me with a great deal in this regard.

"I am deeply touched by your concern and wish to promote the success of my work, but, I must confess, that I fear that you may have overestimated its importance on the basis of some indulgent references by Meitner and others. Again I thank you for all the help you have given me. Judging from Russian newspapers, we will have the pleasure of seeing you in Russia in August at the Congress.

"With best regards, yours truly,
"D. Skobel'tsyn"
"25 October 1928

"Dear Pavel Sigizmundovich,

"Please allow me to inform you that I have been notified by the Paris representatives of the Rockefeller Committee that in a few days I will receive a stipend for work at the Curie Institute for a period of one year, thus successfully concluding the efforts begun on your initiative. I hope that the various difficulties which must yet be overcome in order to begin and arrange my work in Paris will be removed in one way or another, but of course I will not be able to eliminate them before the beginning of next year, which was taken into consideration at the time of the negotiations which took place this summer in Paris.

"I hope that the remaining time will be sufficient to complete, more or less, the observations which I am conducting now, which seem to me to be very favorable. The need to complete this work was the main motive to refuse your kind offer to continue my summer visit abroad, which I wrote to you about from Cambridge.

"As for the work I just mentioned, I expect that it will yield interesting results. As I wrote you a year ago, I have in mind an experimental verification of the 'intensity' formulas for the Compton effect. At present I already have results which definitely contradict the formulas of Dirac and Gordon and yield what seem to me to be some remarkable coincidences with the Klein–Nishina theory. I reported on my

FIG. 10. Leningrad, November 1968. Left to right: E. A. Strauf, L. A. Sena, D. V. Skobel'tsyn, A. F. Prikhot'ko, Ya. S. Kan, N. M. Reĭkov.

data in September at Copenhagen at the request of Nishina. Besides, this was before I found out about the result of the new theory, which was later published in Nature. It must be said that there is a substantial divergence between my experimental data and the conclusions of Klein and Nishina, which, I am convinced, may not be ascribed to observational errors. Now this must be definitively explained and proven.

"I continue to feel that it is risky to attempt to move my work to Paris as had been decided earlier, since I fear the inevitable difficulties in setting up the entire experiment anew and the fact that some of the necessary conditions for work are absent in the Paris laboratory.

"In conclusion, allow me to thank you again for your very flattering attention, which is valuable to me, and for all you have done for me.

"Yours truly,
D. Skobel'tsyn"

In summary, Skobel'tsyn was delayed in Leningrad until the spring of 1929 (apparently the letters to Ehrenfest, refer to his papers *On a New Form of Very Fast β Rays and Spectral Distribution and Average Wavelengths of Ra γ Rays* which were published in Z. Phys.[25,26] in 1929).

It is interesting to note that in the personal file of Skobel'tsyn[27] at the archives of the Ioffe Physicotechnical Institute that there is a letter from the institute addressed to the customs house in Pskov requesting permission to transport abroad a number of instruments (including a device "to record current" and an electromagnet) needed to rapidly install the experiment on which Skobel'tsyn planned to work at the Radium Institute in Paris. Moreover, he took with him drawings of the installation and 13 working notebooks with rough records, the protocols of measurements, etc., which were being conducted in Leningrad.

Skobel'tsyn appeared in Paris at the beginning of April 1929. One can make judgments about the results of his work from the evaluation given by Ioffe. In the evaluation it is said that Skobel'tsyn's work at the Paris Radium Institute "was mainly devoted to the study of the spectra of γ rays using a method he developed several years ago in Leningrad [a Wilson chamber in a magnetic field–the Authors]. The availability of strong radium preparations at the Institute made it possible for Skobel'tsyn to expand significantly the area of application of this method. He succeeded in accumulating during his assignment a vast amount of experimental material, the analysis of which will no doubt help us to fathom the mechanics of processes occurring in the atomic nucleus. The latter is one of the most urgent problems in modern physics." (Ref. 27, sheet 9) Ioffe concludes by stating that Skobel'tsyn used his appointment very efficiently and productively.

At the Radium Institute Skobel'tsyn worked with P. Auger, who was a coauthor of the published paper *On the Nature of Ultrapenetrating Radiation.*[28] It was during his time in France that "ultra particles" (in the terminology of those years) were discovered, that is, extremely high energy particles in cosmic rays. Cosmic ray showers were also discovered, and further studies were conducted on the Compton effect and γ spectra. Skobel'tsyn's research advanced successfully, and his Rockefeller Foundation stipend was extended for another year. In August 1931 he returned to Leningrad.

Goergiĭ Antonovich Gamov [George Gamow] (1904–1968). In 1922 Gamov entered the first year of Novorossiĭskiĭ University in Odessa. Among the teachers were the mathematicians V. F. Kagan and S. I. Shatunovskiĭ. In 1923 Gamov moved to Petrograd (Leningrad) and continued his studies at Petrograd University, where his talents caught the attention of O. D. Khvol'son, D. S. Rozhdestvenskiĭ, A. A. Fridman, Yu. A. Krutkov, and others. In 1928, on the recommendation of Khvol'son Gamow was sent to Göttingen. Shortly after he arrived he completed a quantum mechanical study of the process of α decay, which he explained in terms of the "tunnelling" of particles through the potential Coloumb barrier. This study became widely known (the study was completed independently of the study of Condon and Gurney, but with a more detailed mathematical calculation which made it possible to make a comparison with experimental data on the processes of α decay, which were established by Geiger and Nuttall in the law which bears their names, and to calculate the radius of nuclei). He was invited to work in Copenhagen with Bohr, with whom he spent about a year (from the fall of 1928), with visits to Rutherford in Cambridge and Ehrenfest in Leyden. When he returned to the USSR in the spring of 1929 he continued his study of atomic nuclei and was nominated by Academician

A. N. Krylov from the Physicomathematical Institute of the USSR Academy of Sciences for a Rockefeller Foundation stipend. Gamov's candidacy was supported by Yu. A. Krutkov, under whose direction Gamov completed his work on the adiabatic invariants of a pendulum oscillating in a gravity field increasing with time (an analog of the Rayleigh-Einstein pendulum).

In his application to the Rockefeller Foundation, Gamov indicated that he had independently studied atomic theory and the new quantum mechanics at Leningrad State University in 1925–1926 and had studied the theory of atomic nuclei under Bohr at the Bohr Institute in Copenhagen in 1928–1929. He was very laconic about his further plans: "To continue work in the field of theoretical physics."[32]

In Gamov's file in the archives of the Rockefeller Foundation are the following descriptions of him:[32]

1) *Sir Ernest Rutherford* (Cavendish Laboratory, Cambridge): "I know Gamov personally, and was in close contact with him while he was conducting his research. I consider him a man of great originality with good mathematical abilities who has developed a very interesting direction in his theoretical studies. I will be glad to provide him the opportunity to work at the Cavendish Laboratory, in which he could interact with colleagues who are conducting studies in the area of his special interests. I strongly recommend Mister Gamov, bearing in mind both his personal qualities and his scientific merits, and I am sure that awarding him a Rockefeller Foundation stipend will help him to achieve very necessary scientific results and will allow Mister Gamov to continue his interesting studies."

2) *Professor R. Fowler* (Trinity College, Cambridge): "I met Doctor Gamov and worked with him at Cambridge and in Copenhagen, and am very glad that he has the opportunity to come [to Cambridge–the Authors] and work here in the coming academic year. I like him as a person, and I have a very high opinion of his intellectual power. His work is characterized by a simply amazing ability to get at the heart of the matter. However, he needs to learn a little in the field of mathematics, and I think that it would be very useful for him to be at Cambridge. He will also be necessary to us, since the power of his imagination is simply amazing. I am confident that if he obtains the stipend, and of this I am sure, that the group of experimentalists working here in the field of nuclear physics would successfully collaborate with Doctor Gamov."

3) *Doctor Tysdale* (during his visit to Copenhagen on 25 April 1929): "Professor Bohr has acquainted me with a young Russian, Gamov, who returned from Leningrad about a week ago. He worked with Bohr as a stipend recipient of the Danish Academy for six months, and Bohr said that Gamov is another Heisenberg. Gamov would like to work with Rutherford and his colleagues on the problem of the splitting of atomic nuclei ... Awarding Gamov a stipend should be considered a primary task, even if only part of what Bohr said about him is true."

As a result it was decided to award to Gamov a yearlong Rockefeller Foundation stipend with a monthly award of 120 dollars and payment for his travel (in particular the "shuttle" from Copenhagen to Cambridge).

During the year of his Rockefeller Foundation stipend Gamov continued successfully to study problems in the physics of the nucleus. He had a great effect on the work of Cockcroft and Walton on artificial splitting of nuclei with protons, calculating the intensity of the beam of protons, which, despite the relatively small energy of the protons (compared to the height of the Coulomb repulsive barrier), generated the reaction to transform the nuclei. He completed a number of studies on the theory of α decay, the theory of the nucleus (the liquid-drop model), and prepared for publication a monograph on this subject, which was published in a series of international physics monographs by the Oxford University Press (the editors of the series were Kapitsa and

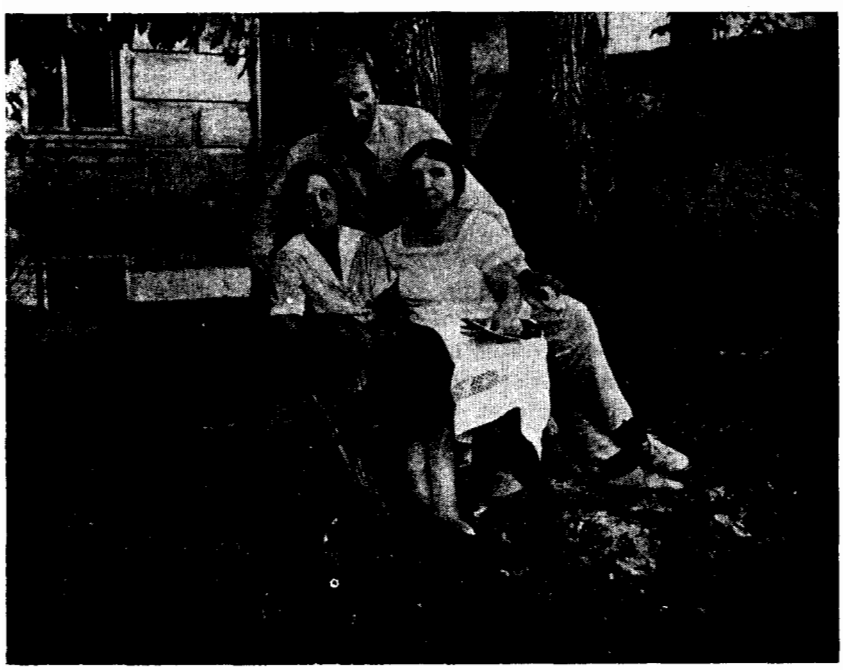

FIG. 11. Odessa, 1926. G. A. Gamov with classmates in the mathematics department of the Novorossiĭskiĭ (Odessa) University. Left: T. N. Kasterina; right: N. ?. Zhuravskaya.

Fowler).[33] The monograph was also published in the Soviet Union.[34]

When he returned to Leningrad, he worked at the radium, physicotechnical, and physicomathematical institutes. In 1932 he was elected to be a corresponding member of the USSR Academy of Sciences. In 1933 he traveled to the Solway Congress in Brussels and did not return to his homeland (he repeatedly requested that his assignment be extended). In 1938 he was stripped of his title of corresponding member (the title was posthumously restored in March 1990). In 1934 he worked in the USA. He carried out classical investigations in astrophysics (the prediction of relic radiation, the Big Bang theory) and genetics (the genetic code).[13)]

Lev Davidovich Landau (1908–1968).[35–37] When he completed secondary school in Baku in 1921, Landau entered Azerbaijan University. He studied in the physics and mathematics and chemistry faculties from 1922 to 1924. In 1924 he transferred to the physics and mathematics faculty of Leningrad State University. Here he was in close scientific contact with students of that same faculty, M. P. Bronshteĭn, G. A. Gamov, and D. D. Ivanenko. In the beginning of 1927 he graduated from Leningrad State University, defending his diploma work on the theme *The Theory of the Spectra of Diatomic Molecules*. He was accepted for graduate work at the Leningrad Physicotechnical Institute with Frenkel'. By this time Landau was already a full-fledged scientist who required no guidance. He continued to work at the Physicotechnical Institute as a staff member of the theoretical division. In summer 1928 the question arose of sending the young Landau abroad. This trip in 1929 was realized with the funding of the People's Commissariat of Education. From the account of the trip (presented below) it is clear that despite the opinion of the Rockefeller Foundation representatives, Landau was awarded a stipend. Unfortunately, his file is missing in the Rockefeller Foundation archives. There is only one small document which is presented below.

While he was abroad in 1929 Landau met Ehrenfest, who probably played his "standard" role in the recommendation of the Soviet physicist to receive a Rockefeller Foundation stipend. As far as we can see, Landau's half-year assignment was converted in a "smooth transition" to his assignment on a Rockefeller Foundation stipend. It may be assumed that the recommendation of Ehrenfest was supported by Bohr and/or Pauli.

The document from the Rockefeller Foundation archives[38] contains the following information. The candidacy of Landau was examined at the Rockefeller Foundation meeting of 10 April 1930, and was approved. He received a stipend of 150 dollars (monthly). His initial stipend was for nine months, but later it was apparently extended to summer 1931.

Hereinafter we quote the document:

"The problems which Landau has studied during the period of his stipend are as follows: study of the problem of quantum revision of electrodynamics, the theory of electric conductivity, and the n-body problem in wave mechanics. Contacts: with Professor P. A. M. Dirac, Cambridge, England, Professor W. Heisenberg, Leipzig, and Professor W. Pauli, Zurich. Opinions: Professor Ya. Frenkel', Roentgen Institute, Leningrad: "He graduated from Leningrad University at 19 years of age and for the following two years worked at the Physicotechnical Roentgen Institute studying various problems in quantum mechanics. Despite his youth, he is one of the best specialists in this field, in which he has already made a number of contributions of great interest and importance."[38]

We now present Landau's account of his scientific assignment, which is kept at the archives of the Physicotechnical Institute and has not been previously published. The ac-

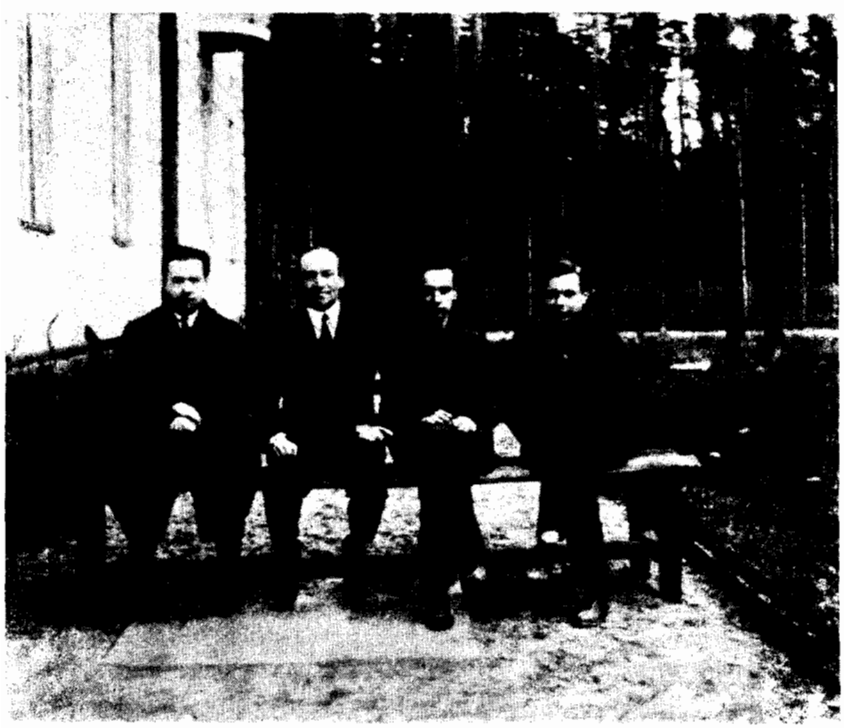

FIG. 12. Leningrad, end of the 1920s. Staff of the theoretical department of the Physicotechnical Institute. Left to right: B. N. Finkel'shteĭn, Ya. I. Frenkel', L. D. Landau, D. D. Ivanenko.

count is accompanied by brief comments (see footnotes 14–17).

"Account of the Foreign Assignment of Staff Member of the State Physicotechnical Roentgen Institute, L. D. Landau (Ref. 39, sheets 1–4). From September 1929 to April 1930 I was on foreign assignment for the People's Commissariat of Education, and then until March 1931 I was on a Rockefeller stipend. During this time I had the opportunity to work in contact with the most outstanding of today's theoreticians. Those who have had the greatest influence on my work were N. Bohr (Copenhagen), W. Pauli (Zurich), and W. Heisenberg (Leipzig).

My scientific work developed in several different directions during this period. A significant portion is occupied by the central question in theory today (the word "theoretical physics" is inappropriate since it relates to every other "theoretical" science, for example, theoretical chemistry, astronomy), that is, the problem of uniting the two most general contemporary theories: the principle of relativity and the theory of quanta. This problem has led to immense complications, which have made its accurate resolution an issue for the distant future. My first paper (with R. Peierls), which was devoted to this problem, showed that some of these difficulties, the so-called energy of radiation, may be eliminated by introducing the wave mechanics of light quanta. This mechanics, while it does not penetrate all of the fundamental difficulties, nonetheless makes possible an extremely simple analysis of various physics problems (reprint attached to report). I then participated in a theoretical conference devoted to these problems in Copenhagen in April 1930. This conference led to a more explicit statement of the problems and played a fundamental role in the further development of our science. Finally, recently Peierls and I have succeeded in obtaining further results in this field. We have shown, on the basis of an analysis of possible experiments, that the basic physical principles of wave mechanics, which make it possible to apply it, are not satisfied in the presence of a limited propagation speed. Earlier, this doomed to failure all attempts to generalize directly wave-mechanical methods for the case of the relativistic theory of quanta, attempts which have recently become extremely frequent in the world literature. On the other hand, the inequalities which we have established, which are a further generalization of Heisenberg's famous uncertainty principle, make it possible to understand the basic condition and character of the full theory of the problem, which is yet unknown to us. In particular, this approach makes it possible to explain the existence in the β decay of radioactive nuclei of a continuous distribution of velocities of outgoing electrons, a phenomenon which, due to its abrupt contradiction of the law of conservation of energy (N. Bohr), cannot be completely interpreted from the point of view of modern theories.[14)]

"Another main result of my work abroad was a study of the problem of the origin of stellar energy and the internal structure of stars. This problem has generated the current lively polemic among astrophysicists, in particular, between Eddington and Milne. I showed that the main assertions, which are usually selected as the basis of calculation, lack a physical sense. I also explained that in reality in stars a stellar core should be formed which is compressed to the density of atomic nuclei. This core is the source of radiation because the law of conservation of energy does not apply to nuclei and analogously constructed systems (this work is in press at present).[15)]

"In addition to the indicated problems I have also studied a number of special problems. This includes work on the origin of the diamagnetism of metals, where I have shown that wave mechanics, contrary to widespread opinion, leads to the diamagnetism value in free electrons as well (reprint of work attached).[16)] Further, I studied the problem of the so-called continuous spectrum of protons from nuclei split by α particles (article being prepared for publication)."[17)]

To Landau's report is attached (dated 15 June 1931) a copy of the report "On the Work of Landau during his Foreign Assignment" compiled by Fok. We present from this only the conclusion: "The work of L. D. Landau performed during his assignment is of significant scientific value; ...the goal of his assignment has been achieved with great success." (Ref. 39, sheet 5)

The route of Landau's foreign assignment can be established from various sources in the literature and appears as follows: Leningrad-Berlin-Leipzig-Copenhagen-Leyden-Zurich-Cambridge-Zurich-Copenhagen-Leningrad (beginning of the summer of 1931).

In conclusion we would like to stress that a significant part of this article, as can be seen from the references, is based on materials of the Rockefeller Foundation archives. Soviet readers will probably be interested in reading about this archive, if only in a few lines. It is located in North Tarrytown, a picturesque suburb of New York, on rather extensive land which is the private property of the Rockefeller family. At the archives all conditions are created for the work of researchers: rapid completion of requests, assistance in the search for materials, the ability to make quickly xerox copies of these materials (at the expense of the Rockefeller Foundation or the researchers themselves). The archives themselves are located in a two-story cottage which was a gift of David Rockefeller to his wife. We note that the walls of the halls of the archives are decorated by about 20 water colors by Chagall, who painted the family church of the Rockefellers, which is not far from the archives building.

We would like to express our gratitude to the director of the archives, Doctor D. Stapleton, for his assistance with this work. In footnote 9 we also mention A. E. Engberts and V. V. Ivanov, who helped to obtain the materials from the Ehrenfest archives in Leyden. We are also grateful to L. F. Gavrikova of the archives of the Ioffe Physicotechnical Institute of the USSR Academy of Sciences.

[1)] During 1913–1921 the main attention of the Rockefeller Foundation was directed toward supporting technical sciences and their applications, as well as public health. In the 1930s and 1940s emphasis shifted to biologists, as well as those physicists and chemists who could conduct new studies in this field using appropriate methods, instruments, and equipment.

[2)] It is possible that this proviso was associated with the fact that somewhat earlier Bezikovich, a student of V. A. Steklov, having obtained a Rockefeller Foundation stipend with Ehrenfest's assistance (his initiative was supported by Harald Bohr, a well-known mathematician and the brother of Niels Bohr), at the end of the period did not return to the USSR. He remained abroad, uniting his life and work with England. Almost the same situation occurred with the Leningrad geneticist Feodisiĭ Grigor'evich Dobzhanskiĭ (1900–1975), who is correctly deemed one of the greatest biologists of the twentieth century. He received a Rockefeller Foundation stipend in 1927, was sent to the University of California, and remained in the US.

[3)] We express our sincere gratitude to I. I. Shafranovskiĭ, who communi-

cated to us additional information about B. P. Orelkin, and to M. G. Rodrigues, who informed us about P. Ya. Davidovich.

[4)] Hereinafter this abbreviation will also indicate "recipient of a Rockefeller Foundation stipend [This footnote refers only to the Russian text].

[5)] Only one document has been preserved about Landau, thus doubts have been expressed even at the Rockefeller Foundation archives that he received a Rockefeller Foundation stipend; the authors of the article have tried to dispel these doubts using the archive documents published below.

[6)] In fact Ehrenfest gave only one optional year-long course at the Polytechnical Institute.

[7)] This probably means the assistance that Ehrenfest rendered to the first Soviet delegations abroad (1920–1921).

[8)] In his memoirs, Born recalls that among the physicists who actively participated in the work of the Institute of Theoretical Physics (University of Göttingen), which he headed, were (of the Rockefeller Foundation stipend recipients) V. A. Fok and Ya. I. Frenkel', as well as Yu. B. Rumer and I. E. Tamm.[19]

[9)] These letters are preserved in the Ehrenfest archives in the Leyden archives; there are also copies of the materials of the archives in the US. They were obtained from Leyden with the kind assistance of A. E. Engberts (Leyden) and V. V. Ivanov (Leningrad).

[10)] On the other hand, in Zh. Rus. Fiz. Khim. Obsh. [Journal of the Russian Physical and Chemical Society (1879–1930)] alone Sinel'nikov published six papers during the indicated time period. Apparently the "count" here is of publications in foreign journals.

[11)] In the indicated collection[24] there are also materials related to the biographies of Gamov, Landau, Krutkov, Fok, and Frenkel'.

[12)] See footnote 9 (in the section on Fok). What is stated there is also true of the correspondence between Ehrenfest and Curie.

[13)] Since very little has been written about Gamov (see, for example, Refs. 30 and 31), we took the liberty of concisely selecting stages of his biography after he completed his work as a Rockefeller Foundation stipend recipient.

[14)] He has in mind two papers by Landau and Peierls: 1) *Quantum Electrodynamics in Configuration Space*;[40] see Russian translation in Ref. 4, pp. 32–46; 2) *The Extension of the Uncertainty Principle to Relativistic Theory*,[42] Russian translation in Ref. 41, pp. 56–70. Both works were completed in Zurich, respectively during Landau's first and second trips there. See R. Peierls[43] and E. M. Lifshits[37] about these works.

[15)] This paper, which was completed in Zurich, was published in 1932 in the first volume of the Soviet physics journal Phys. Z. d. Sowjetunion, published in Kharkov[44] (Russian translation, Ref. 41, pp. 86-89). The work was further developed in Landau's article *On the Sources of Stellar Energy*;[45] for the English translation, see Ref. 46; see also Ref. 41, pp. 224–226. The concept of neutron stars was advanced in these works.

[16)] The work *The Diamagnetism of Metals*[47] (Russian translation, Ref. 41, pp. 47–55) was done while Landau was at the Cavendish Laboratory in Cambridge. He discussed it with Pauli in Zurich and Kapitsa in Cambridge. It contains a classical conclusion about the diamagnetism of free electrons in metals. In addition it presents the concept of so-called diamagnetic levels, which was obtained independently in the works of Rabi (1928) and Frenkel' and Bronshteĭn (1930); see Ref. 48.

[17)] The work was not published.

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