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CENTRAL INTELLIGENCE AGENCY
WASHINGTON 25, D. C.

21 March 1955

MEMORANDUM FOR: Mr. Gerard C. Smith ✓
Dr. A. K. Brewer
Col. Geo. E. McCord

SUBJECT: Section 73 (Atomic Energy) NIS 26 (USSR).

1. Attached for your review is the Atomic Energy Section of NIS 26, USSR. This is the result of the revision of a draft originally distributed to you in December 1954.

2. It is requested that any suggested changes be presented as soon as possible so that a discussion aimed at coordinating this NIS might begin on or about 6 April.

3. After coordination, an edited draft will be prepared by the Production Staff/OSI, and a copy will be distributed to you. It is requested, that the attached draft and the December draft be returned to Nuclear Energy Division at that time.

F. A. Valente
F. A. VALENTE

Attachment
Chapter 7 - NIS 26
Section 73 (Atomic Energy)
#3

SPECIAL ASSISTANT TO THE SECRETARY
S/AE
MAR 23 1955
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This [redacted] contains information [redacted] the national [redacted] within the meaning of the [redacted] Title 18, USC, Secs. 793 and 79[redacted] or revelation of which [redacted] manner to an unau[redacted]ed person is prohibited by law.

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CHAPTER VII - NIS 26

SECTION 73

ATOMIC ENERGY

This is a preliminary draft of Section 73, NIS 26. It has not been finally edited or reconciled with other NIS Sections and should not be reproduced.

This Section approved by the JAEIC for use in the NIS

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73. Atomic Energy

A. General

1. Early History

There is clear evidence of Soviet research interest in atomic energy dating back to the discovery of the fission phenomenon in 1939. During the war years, the USSR conducted organized basic research in the field of atomic energy. In November 1945 the "First Chief Directorate attached to the Council of Ministers" was organized under Beria to plan and carry out the USSR atomic energy program.

In 1945, the USSR undertook a major program in occupied areas to obtain materials, personnel, and equipment of potential value to an atomic energy program. For example, ores and compounds containing about 100 tons of uranium metal were obtained in Germany and Czechoslovakia and moved to the USSR; German and Austrian scientiests were recruited for work in the USSR; and possibly as much as one ton of heavy water was confiscated from German stocks. Uranium mining operations were begun in late 1945 on deposits in Czechoslovakia and Bulgaria and shortly thereafter in Germany and Poland. Exploitation of Satellite uranium increased rapidly until 1950.

Available evidence concerning Soviet espionage warrants the inference that Soviet atomic energy research, plant design, construction and operation were carried out with considerable knowledge of the U.S., U.K., and Canadian atomic energy programs. Although this espionage assisted the early Soviet progress by at least establishing guide lines for research, extensive independent research by the Soviet was required to accomplish thier program. Also, it is evident that in a number of important instances Soviet practices do not follow those of the western countries mentioned.

Early in the Soviet program, development was undertaken on methods of production of plutonium and uranium-235. The plutonium peogram progressed more rapidly and was the source of the first Soviet fissionable material.

Early evidence of interest in reactor construction was revealed by a Soviet production program for heavy water, which could only be used in reactors. Although details on the progress of reactor research and the specific types of reactors built are lacking, the first Soviet reactor capable of quantity production of plutonium probably went into operation during 1948 at an installation in the Urals. The success of the plutonium production and processing program and of the weapon development program was demonstrated by the use of plutonium in the nuclear weapon tested in August 1949.

The USSR undertook an extensive research program on isotope separation concurrently with research for the reactor program. German scientists assisted in this program and carried out specific projects relating to the gaseous diffusion and electromagnetic processes as well as other methods. The success of the program was demonstrated by the use of U-235 in a weapon tested in October 1951. It is believed that the first Soviet U-235 was produced by the electromagnetic process at a second installation in the Urals and that facilities employing the gaseous diffusion process were constructed and brought into operation subsequently at a third Urals site.

2. Growth of the Program

The USSR atomic energy program has undergone a major and continuing expansion since the initial achievement of the production of plutonium and the experimental test of the first nuclear weapon.

In 1950, with the rapid growth of the uranium procurement program, the "Second Chief Directorate attached to the Council of Ministers" was organized to direct these activities. Production in East Germany has been maintained at the very high levels reached in 1950, and production in the USSR and in the other Satellites has continued to increase. It is estimated that a total of approximately ~~4,000~~ 4,500 tons of uranium (in terms of recoverable metal) was mined in 1954 in the USSR and its Satellites, including East Germany. While this figure is subject to a considerable uncertainty as a result of the inconclusive nature of the evidence on internal USSR efforts, approximately

2,000 tons of this total are estimated to have come from East Germany, and this figure is considered to be subject to an uncertainty of not more than plus or minus 25 per cent.

Major expansion of fissionable material production facilities at the Urals sites occurred. Two major new atomic energy installations have been built in Central Siberia, and it is believed that these are engaged in fissionable materials production.

The expansion of plutonium production in the USSR has been revealed by a rapid increase in the total USSR reactor power level. The increase in power level has probably resulted from an expansion of the original reactor site and the construction of a new site. The growth of the facilities for production of heavy water, used in the construction of reactors, is supporting evidence for increased plutonium production. The heavy water facilities were greatly expanded in 1949-50 and have continued to grow since that time.

Growth of uranium isotope separation activities is revealed by the USSR procurement of materials for the construction of isotope separation facilities and the continued increase in the supply of electric power available at the isotope separation plants. Beginning in 1948 and continuing through 1952, the USSR purchased very large quantities of nickel wire mesh in East Germany. This material reportedly was used in the fabrication of barriers for gaseous diffusion isotope separation plants. The quantity of material purchased and the period during which it was procured are indications of the continued growth of the isotope separation plants. Very large quantities of electric power are required for the operation of isotope separation facilities on an industrial scale. The quantity of electric power available at the USSR isotope separation sites has increased markedly since 1950, indicating an expansion of the isotope separation activities. It is probable that a third isotope separation facility has been built, in addition to the two in the Urals.

The controlling organizational structure of the USSR atomic energy program, the First Chief Directorate and the Second Chief Directorate attached to the Council of Ministers, continued without substantial change from 1950 until the downfall of Beriya in 1953. Coincident with Beriya's arrest, an organization known as the Ministry of Medium Machine Building was organized, and shortly thereafter Malyshev was designated as minister in charge. Although the activities of this ministry have not been publicly defined, it is responsible for at least a part of the Soviet atomic energy program and is probably responsible for the overall administration of the program. The administrative changes following Beriya's arrest do not appear to have adversely affected the progress of the Soviet atomic energy program.

The history of the construction of the fissionable material production plants, located in the Urals area and in Central Siberia, is generally clear from a variety of evidence. However, important details remain undetermined, and these introduce a measure of uncettainty in the estimates of production. Nevertheless, information on the availability of uranium, the timetable of construction, the size of facilities, the quantity of heavy water available for reactor use, the total reactor power level, the procurement of nickel wire mesh, and the power available at various sites, particularly those engaged in isotope separation, provide consistent support of the estimates of cumulative USSR fissionable material stockpiles to the end of 1954, which follow:

Date	Plutonium
Mid-1949	10 kilograms
Mid-1950	50 kilograms
Mid-1951	100 kilograms
Mid-1952	300 kilograms
Mid-1953	600 kilograms
Mid-1954	1,200 kilograms
End of 1954	1,500 kilograms

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Date	Uranium-235
Mid-1951	30 kilograms
Mid-1952	150 kilograms
Mid-1953	350 kilograms
Mid-1954	900 kilograms
End of 1954	1,500 kilograms

The USSR now has a full-scale atomic energy program in operation directed towards the support of a war-making potential. Thus far, this support has been evident inthe form on nuclear weapons--Soviet tests were made in 1949, 1951, 1953 and 1954. No clear evidence is available on Soviet efforts with respect to military power or propulsion applications. However, in view of the increasing size of Soviet fissionable material stockpiles and announced interest in the non-military power applications of atomic energy, some effort on military aspects of this problem is undoubtedly being expended.

On the basis of information now available, it is concluded that the USSR is capable of producing nuclear weapons with explosive powers in the range of a few thousand tons of TNT to approximately one million tons of TNT. [redacted] Furthermore, small diameter, light-weight types yielding from 5 to 60 kilotons for use in bombs or in warheads for weapons other than bombs are considered to be available. Within these technical capabilities military requirements will govern the allocation of available Soviet fissionable material among various types and yield of weapons.

Based on Soviet tests, it is believed that the USSR will probably stockpile weapons of large (1,000 kilotons each), medium (40 [redacted] kilotons each) and small (5[redacted] kilotons each) yield. While there is no clear evidence which can serve as a guide to an estimate of the specific types and numbers of each type that the USSR will actually stockpile, the weapons stockpiled will, for the immediate future, probably have the general characteristics and explosive powers of models tested.

B. Organization of the USSR Atomic Energy Program

1. General

The Soviet atomic energy program formally started with the formation in August, 1940, of the Commission on the Uranium Problem attached to the Praesidium of the Academy of Sciences "to fix the subjects of scientific research work by Institutes of the Academy of Sciences of the USSR in the field of uranium research; to organize an examination of the methods of separating or enriching uranium isotopes and of researches into the control of the processes of radioactive decay; and to effect coordination and general guidance of the scientific research work of the Academy of Sciences of the USSR on the uranium problem. V. G. Khlopin of the Leningrad Radium Institute was its first President; the other thirteen members were clearly representatives of those various laboratories expected to be major contributors on the problem.

In late 1943 the Ninth Directorate of the NKVD was organized to make preliminary studies in the field of nuclear physics with special regard to the question of atomic energy. In November, 1944, the uranium mines in the Fergana Valley area were removed from the jurisdiction of the Chief Directorate of Rare Metals, Ministry of Non-ferrous Metallurgy, and reorganized as Combine #6 of the Ninth Directorate, NKVD, with headquarters at Leninabad. Starting in May, 1945, the Ninth Directorate contracted with over two hundred German and Austrian scientists to work in the USSR on atomic energy problems at several new laboratories subsequently built for this purpose.

Meanwhile, Laboratories 1, 2, and 3 of the Academy of Sciences were organized as the central laboratories in the atomic energy program. Since there is clear evidence of the collaboration of Laboratory 2 with the Ninth Directorate, NKVD, in the selection of German scientists to work on atomic energy problems, it is probable that the activities of the Academy of Sciences and the NKVD in the field of atomic energy were coordinated through L. P. Beriya in his capacity as President of the State Defense Committee of the Council of Ministers between September 1944 and September 1945.

2. Establishment of top level direction

a. The First Chief Directorate attached to the Council of Ministers

In October or November, 1945, the First Chief Directorate attached to

Council of Ministers (FCD) was created with the responsibility of fulfilling the overall objective of the Soviet atomic energy program. Leaders of industry from various ministries were brought into the new organization, men who, for the most part, retained their old jobs along with their new responsibilities. For instance, Colonel General Boris Lvovich Vannikov who was appointed head of the FCD kept, for the time being, his position as head of the Ministry of Agricultural Machine Building.

Beriya retained overall direction of policy as the responsible member of the Council of Ministers. He drew into the program the highest political, administrative, technical, and scientific leadership of the nation in order to achieve the program objectives in the minimum possible time. In June, 1946, Vannikov resigned his post as head of the Ministry of Agricultural Machine Building in order to give his full time to directing the affairs of the FCD. However, others kept their former positions while continuing to serve the atomic energy project. (Figure 1 shows the structure of the Soviet atomic energy program as it was in 1949).

During the period 1945 - 1950 the FCD gradually took over the responsibilities of the Ninth Directorate, NKVD. Finally, in early 1950, the Ninth Directorate relinquished the last of its functions, control of German scientists in the USSR, to the FCD and was at that time dissolved.

b. Creation of the Second Chief Directorate attached to the Council of Ministers

With the steady growth of the Soviet atomic energy effort, a major reorganization took place in early 1950, at which time a Second Chief Directorate attached to the Council of Ministers (SCD) was formed. The new organisation took over the problems of mining, concentrating and refining of uranium as well as the development of new uranium deposits. The FCD was thus free to concentrate its efforts exclusively on the production of fissionable materials and the manufacture of weapons. Simultaneously, the supply, personnel, and other services held in common were placed in a separate body serving both the First and the Second Chief Directorates.

Included in the organisation of both the FCD and the SCD and was a collegium composed of senior officials, including the head of each chief directorate (i. e., FCD and SCD) and his deputy, the chiefs of directorates and their deputies, and certain ministers. These boards act solely in advisory capacity on policy matters to the heads of the FCD and SCD.

3. Probable current organization

During the ministerial reorganization which began after Stalin's death in March, 1953, several of the chief directorates attached to the Council of Ministers were transferred to the ministries to which their functions properly belonged; several others remained attached to the Council of Ministers. The disposition of the First Chief Directorate and the Second Chief Directorate is unknown, but there is no reason for assuming a change in status at that time.

In June, 1953, at the time of Beriya's arrest, the Ministry of Medium Machine Building was formed with V. A. Malyshev as its Minister. Later, when the formation of the Ministry was announced, it was suggested that Malyshev had suceeded Beriya as director of the overall policy of the atomic energy program. Malyshev was in fact raised to the rank of Deputy Chairman of the Council of Ministers in December, 1953, (a position he had held prior to Stalin's death) thus strengthing the belief that he might be Beriya's successor in the field of atomic energy.

There is not sufficient information to define clearly the administrative structure of the program since June, 1953. There is evidence that the Ministry of Medium Machine Building is involved in the program, but the extent of its involvement is not known. Neither is it known whether the FCB and SCD still exist. There is some evidence that the organization may still be in a state of flux. There appears to have been a centralization of authority, and it is possible that a single organization at the ministerial level now exercises the functions which were formerly divided between the FCD and SCD.

4. Historical organization of the FCD

The history of the organization prior to June, 1953, is fairly well known. A summary of the structure and functions may be of value, since the functions of the old organization must still exist in the new.

5. Administrative function of the FCD

Vannikov's staff exercised executive functions concerned with plans, industrial and technical control, and capital construction. The staff included a board of consultants in addition to personnel assigned specific responsibilities. Liaison was maintained between the FCD and several important organizations, including the Ministries of the Interior (MVD) and of the Chemical Industry as well as the MGB.

6. FCD direction of industrial operations

Several of the members of Vannikov's staff were officials whose function it was to direct field operations, and it is not unlikely that he had a deputy for field operations. It was in this manner that Vannikov maintained contact with and control over field operations which include industrial installations such as uranium metallurgical plants, nuclear reactors, isotope separation plants, and weapons fabrication installations. A certain degree of control over installagions of other Ministries vitally concerned in the atomic energy effort was possible because of the dual responsibilities of some of the senior officials. For example, as Minister of the Chemical Industry and Deputy Chairman of the Council of Ministers, Pervukhin was able to expedite the necessary support provided by the chemical industry and other industries.

7. FCD direction of capital construction

Formerly Lieutenant General Avraamii Pavlovich Zavenyagin, Deputy Minister of the MVD and de facto First Deputy of the FCD, was responsible for all FCD construction. Not only did he control the activities of the FCD construction engineers, but he also directed the atomic energy construction projects of the Chief Directorate of Industrial Construction (Glavpromstroy), MVD. Glavpromstroy is an organization set up to carry out heavy industrial construction throughout the USSR and has been the general contractor to construct all atomic energy installations. In addition to his responsibility for FCD Construction Zavenyagin apparently also retained control of the Ninth Directorate until its dissolution in 1950.

The choice of Zavenyagin for such apposition was a logical one. He was at one time head of the Norilsk Combine and later of the Ninth Directorate, NKVD. As Deputy Minister of the MVD he was in a position to ensure on a first priority basis the successful completion of the many construction projects for the atomic energy program. This was particularly necessary during the immediate post-war years when heavy industrial enterprises were being built or reconstructed throughout the USSR and materials and manpower were at a premium.

8. Scientific and technological control by the FCD

The major research effort necessary for the establishment of the Soviet atomic energy program was coordinated by the FCD and carried out in installations under the control of the FCD, Academy of Sciences, and various ministeries. Although the details of the administration of research are not known, certain personalities and organizations have been identified with portions of it. For example, research for the atomic energy program in the institutes of the Ministry of the Chemical Industry was coordinated by Pervukhin in his dual capacity as First Deputy to the head of the FCD and Minister of the Chemical Industry. Zavenyagin, in his role as Deputy Minister of the MVD, directed the work of the German and Austrian scientists under the 9th Directorate of the MVD. The FCD also worked very closely with laboratories of the Academy of Sciences in research on fissionable material production and other scientific problems.

9. FCD responsibilities for personnel and security

Personnel and security matters were originally entrusted to MGB Lieutenant General Pavel Yakovlevich Meshik, who was well experienced in intelligence and counter-intelligence. His background included many years in Soviet security organizations---the OGPU, NKVD, NKGB, MVD, and MGB--and at one time he was the People's Commissar of Internal Affairs (NKVD) of the Ukrainian SSR. Meshik had a hand in hiring important specialists and inassigning personnel to atomic energy installations, including those outside the USSR. He kept tabs on all personnel through the Special Division of the FCD and its numerous Special Sections which permeated the Chief Directorate and formed its internal intelligence organization. The Special Division, was in fact an MGB organization, but was attached to the FCD and operationally subordinate to it. He was responsible for the security accounting for all classified material, whether documents, freight, or installed equipment. He was also responsible for the physical security of installations, including the supervision of MGB armed guards and fire protection personnel.

When the SCD was established, it is probable that the responsibility for personnel and security matters was transferred from the FCD to a third chief directorate responsible for administration and services.

10. "Quartermaster functions" of the FCD

Procurement, transport, storage, and maintenance of supplies and equipment--"quartermaster functions"--were the responsibility of Major General Kostygov. The greater part of these functions was accomplished by the Material & Technical Supply Directorate (UMTO), supervised by one of Kostygov's subordinates. The handling of supplies and equipment which are sensitive from the security point of view, however, was done by the Technical Supply & Transport Section, supervised by another of Kostygov's subordinates. In addition to these primary quartermaster functions, Kostygov also supervised such miscellaneous activities as motor pools, transport aircraft, schools, clubs, and printing facilities.

When the SCD was established, it is probable that these functions were taken over by a third chief directorate responsible for administration and services. It is believed, however, that small personnel and security, finance, and supplies offices were located within the FCD to maintain liaison with the Services Chief Directorate and to deal with special problems.

11. Responsibilities of the SCD

a. General

Originally, the development of new uranium deposits and the mining and concentrating of uranium ores were the responsibility of a directorate of the First Chief Directorate under Petr Yakovlevich Antropov. Then in January or February of 1950, the Raw Materials Directorate, Antropov's directorate, of the FCD was separated from its parent organization and formed into the Second Chief Directorate attached to the Council of Ministers (SCD). Antropov was retained to head the new organisation. An engineer and geologist by training and former Deputy People's Commissar of Nonferrous Metallurgy, he has had broad practical experience and enjoys an excellent professional reputation. While head of the SCD he maintained close contact with the Ministry of Geology and probably directed certain of its activities of interest to the atomic energy program. When the Ministry of Geology and Conservation of Minerals was organized in September, 1953, Antropov was named Minister.

The organisation and all of the previous functions of the First Chief Directorate remained essentially the same, except for the elimination of responsibility for raw materials operations. Thus Vannikov, Pervukhin, Zavenyagin, Meshik, and Kostygov continued to direct in the spheres which have been indicated. Kostygov continued to act for the two Chief Directorates, and Meshik appeared to retain a measure of authority over personnel and security matters within both Chief Directorates. It is likely that this organisational anomaly was a transition toward establishing a third separate chief directorate concerned with personnel, security, and logistic support. Such a chief directorate would relieve the First Chief Directorate and the Second Chief Directorate of the responsibility of those services held in common and would be consistent with Soviet ministerial organisation.

b. Administrative functions

The staff of the head of the Second Chief Directorate, like Vannikov's included a board of consultants. A Colonel Gerashchenko became Antropov's principal deputy at the time of the reorganization. Not much is known about him but he is believed to have been a Deputy Minister of Internal Affairs (MVD) of one of the Union Republics. Gerashchenko appeared to function principally as Chief of Staff to Antropov, and in this position he supervised the staff, the board of consultants, the Party Committee, and the secretariat. In addition, he was responsible for the Directorate's own network of informers, for the personnel section, for security, and for the Special Division and Special Sections; his relationship to Meshik in these matters is not known.

12. SCD direction of mining operations

While Gerashchenko was probably the most important of Antropov's assistants, Nikolai Fedorovich Kvaskov was also in a position of great responsibility. He appears to have been in charge of mining operations in the

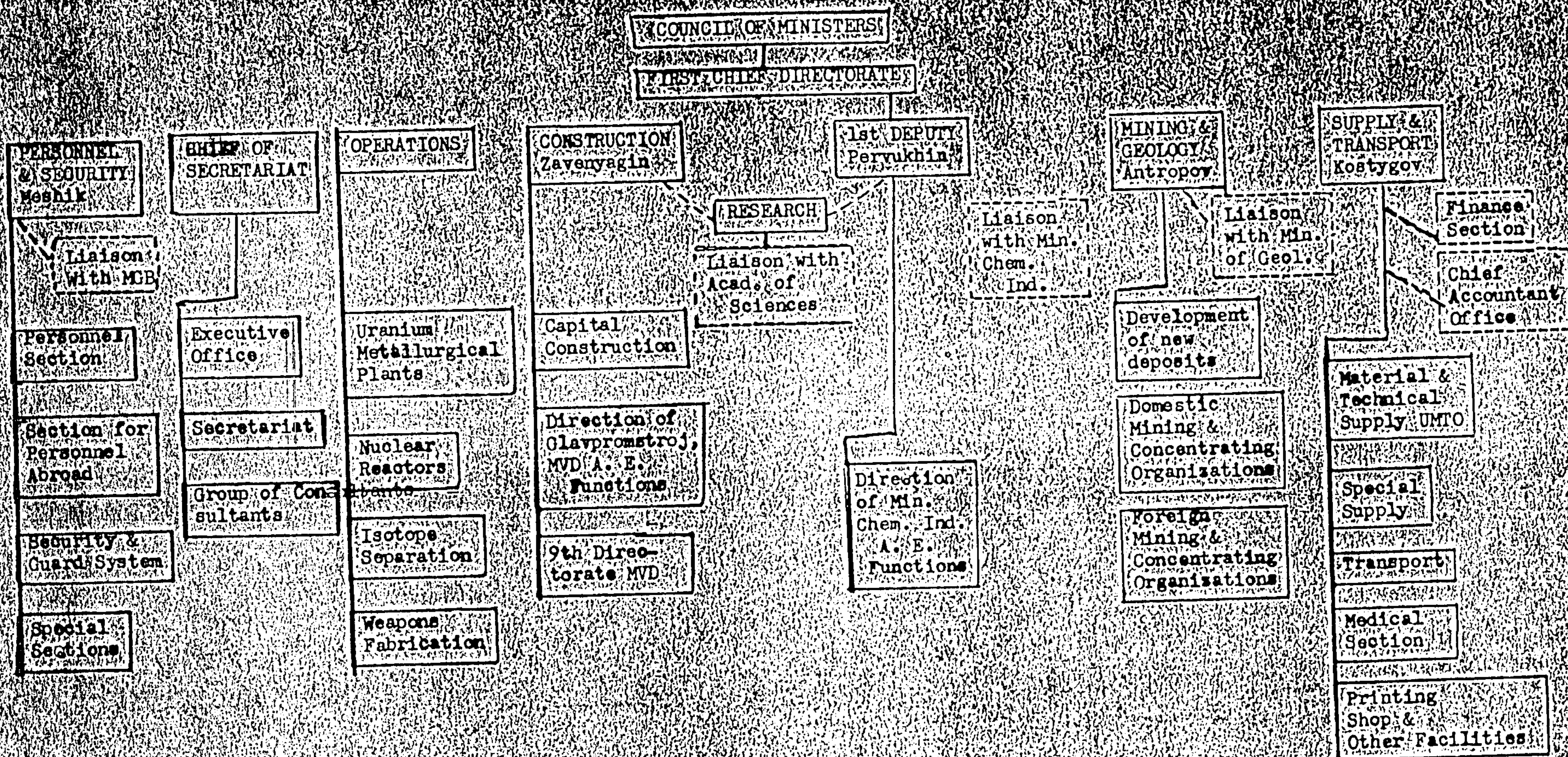
USSR and also abroad. The Soviet Union has returned stock companies jointly owned with the Satellites to the Satellites with the exception of the uranium mining companies. These now appear to be subordinate to the Chief Directorate of Soviet property abroad (GUSIMZ) of the Ministry of Foreign Trade. In addition, Kvaskov exercised supervision over several technical staff functions such as those concerned with engineering, technical security, power supply and capital construction. Such research and development as was done within or for the Second Chief Directorate (by NII-9, for example) may have been supervised by him.

13. SCD personnel administration

The Personnel section was headed by MVD Colonel Andrei Timofeyevich Chichkov, reportedly former Deputy Minister for Personnel of the Ministry of Internal Affairs (MVD) of the Ukrainian Republic. His jurisdiction is this capabtiy may have extended only to personnel admistration, with policy direction being supplied by Gerashchenko through Meshik. Security does not seem to have come under Chichkov, except perhaps in regard to personnel clearances. This section was probably transferred to the Services Chief Directorate. However, personnel and security, finance, and supplies offices would remain within the SCD to maintain liaison with the Services Chief Directorate and to deal with special problems.

14. Geological supervision by SCD

Geological matters were the responsibility of Krasnikov. This includes supervision of prospecting, liaison with the Ministry of Geology and Conservation of Minerals (under which field prospecting expeditions operate) analysis of known deposits, and perhaps a minor amount of research work.



SOVIET ATOMIC ENERGY ORGANIZATION - 1949

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C. A Dollar Valuation of the Post-war Soviet Atomic Energy Program

1. The Valuation of the Program

a. The value, in terms of 1950 U. S. dollars, of post-war additions to Soviet atomic energy facilities is estimated to approximate two billions of dollars. The value of annual operating outlays in 1954 is similarly estimated at $3/4 billion. Present economic intelligence data permit no reliable estimate of the absolute or relative resource costs incurred in the development, maintenance and operation of the Soviet nuclear energy plant. Hence, while common sense limits may be readily ascribed for the nuclear energy program as being from 1/2 to 3 1/2 percent of Soviet gross national product, no basis is available for a more definitive determination or for narrowing the stated range.

b. Tables I and II summarize in detail the 1950 dollar valuations of capital and operating outlays for the Soviet atomic energy program. They were derived by applying 1950 U. S. dollar capital value and operating cost coefficients to available physical estimates of the Soviet atomic plant. It must be noted, however, that the factor of two error inherent in the physical estimate, necessarily carries over into the economic estimates.

COMPARATIVE DOLLAR VALUATION OF THE SOVIET NUCLEAR ENERGY PROGRAM BY CAPITAL PLANT AND OPERATIONAL OUTLAYS (IN ~~000,000~~ millions of 1950 DOLLARS)

	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	TOTAL
1. U-235 Isotope Separation											
a. Operating	-	-	-	-	10	15	45	60	75	90	295
b. Capital	-	-	60	105	145	145	115	95	120	135	920
2. Plutonium ~~Transformation~~ Production											
a. Operating	-	-	-	-	10	10	20	30	45	70	185
b. Capital	-	-	15	75	60	90	145	145	150	150	830
3. Feed Materials Preparation											
a. Operating	-	-	-	-	3	5	8	18	18	18	70
b. Capital	-	2	-	1	4.5	7	4	2	-	-	20.5
4. Mining & Milling *											
a. Operating	10	35	50	135	240	310	380	425	460	500	2545
b. Capital	3	14	35	45	32	27	23	13	-	-	192
5. Heavy Water											
a. Operating	-	-	-	-	5	10	15	15	15	15	75
b. Capital	-	1	4.5	12	6.5	4	-	3	-	-	31.0
6. Weapons Fabrication & Tests											
a. Operating	-	-	-	-	-	3	10	15	20	25	73
b. Capital	-	-	5	10	20	7	8	10	9	-	69
7. Research & Development											
a. Operating	5	5	5	5	7	7	7	7	7	7	62
b. Capital	4	1	10	10	10	10	10	5	5	5	70
8. Other											
a. Operating	10	10	10	10	10	10	10	15	20	25	130
b. Capital	3	2	0.5	2	2	-	-	2	1	-	12.5
TOTAL	35	70	195	410	565	660	800	860	945	1040	5580 **

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TABLE II

A SUMMARY DOLLAR VALUATION OF THE SOVIET NUCLEAR ENERGY PROGRAM, 1945-1954 ON CAPITAL AND OPERATING ACCOUNT (IN ~~000,000~~ millions 1950 DOLLARS)

Year	Total Annual Capital Outlays	Total Cumulative Capital Outlays	Total Annual Operating Outlays	Total Cumulative Operating Outlays	Total Annual Outlays	Total Cumulative Outlays
1945	10	105 *	25	25	35	130 *
1946	20	125	50	75	70	200
1947	130	255	65	140	195	395
1948	260	515	150	290	410	805
1949	280	795	285	575	565	1370
1950	290	1085	370	945	660	2030
1951	305	1390	495	1440	800	2830
1952	275	1665	585	2025	860	3690
1953	285	1950	660	2685	945	4635
1954	290	2240	750	3435	1040	5675 * *

FOOTNOTES TO TABLES I and II

TABLE I: * The heavy Soviet labor inputs in Mining and Milling Activities, both internally and in the Satellites are valued at $100 per man/month. It is to be noted that application of U. S. 1950 wage rates in the $250 range would balloon the valuation of the Soviet controlled mining operation out of all proportion to the balance of the program. $250 would at the same time, hardly correspond to the "real wage" values accruing to the average Soviet or East German miner.

FOOTNOTES TO TABLES I and II

TABLE I: ** Excluding expropriated capital of 95

TABLE II: * Expropriated Capital - 95

** Including expropriated capital of 95

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2. Real Resource Costs

a. The difference between effort and accomplishment, as an economic concept, is that between cost and value. The distinction is one of importance. Known spheres of Soviet "opportunity-cost" advantages and disadvantages in atomic energy developments in comparison with the United States atomic energy program include:

(1) domestic uranium ore resources available for Soviet exploitation are of relatively low grade, and their refining involves heavier resource costs in comparison with the U. S. program. An additional cost factor is the general inaccessibility of many ore deposits.

(2) Access to the East European Satellite ore resources and to cheap labor in mass quantities serves, however to somewhat offset these comparative disadvantages.

(3) The burden placed on the war-disturbed Soviet industry in producing the novel and special quality ingredients and equipment required for an atomic energy program were doubtless heavy by U. S. standards. Again, however, the burden was eased by material left over from the Reparations Account as the means of payment for East German and Austrian goods, Lend-Lease and general Satellite exploitation.

(4) Finally, through modest investment in penetration and espionage, the Soviets enjoyed some of the benefits and avoided parts of the research and development costs incurred by the United States in the pioneering stages of nuclear energy development.

b. Unfortunately, a reasonable "real cost" measurement of these comparative advantages between the U. S. and the Soviet-controlled economies, is beyond our present economic intelligence capabilities. Hence the proportional resource costs of the Soviet atomic energy program in relation to such aggregative estimates as Gross National Product, Defense or Capital Investment expenditures, etc., are subject to such wide margins of error so as to render the results meaningless or even misleading.

c. Obviously, one is not precluded from ascribing common sense extremes to Soviet outlays for atomic energy as a possible percent of gross national production, i.e., 1/2 to 3 1/2 percent. Since such subsectoral components are always fractional and deceptively small, however, their application is limited.

D. Scientific Training Program

The progress of the Soviet atomic energy program to date and its continued development require a major program to train physicists, chemists, metallurgists, and engineers. This training has been largely carried out in Soviet institutes and universities. Most Soviet university bulletins have listed courses in nuclear physics although few have given the detailed contents of these courses. Soviet tests in the fields of nuclear physics, indicate a high level of training at the University level and in addition they have an active program to translate and distribute western technical literature.

Although much of the training of personnel for the atomic energy program took place in institutes and universities, there is evidence that there was also training at the atomic energy sites. Junior scientific personnel have been noted at many of the atomic energy research and production sites, and it is known that some Soviet personnel received training from German scientists at the Sukhumi Research Complex. In addition, it is believed that some degrees from certain institutes may be granted from work done at atomic energy laboratories.

E. Personalities

1. Manpower estimate

The magnitude of the Soviet ~~atomic energy~~ program has necessitated the diversion to it of large proportions of manpower, especially from among scientific, engineering and construction personnel. The following, in the classifications indicated, is an estimate of the personnel directly connected with the Soviet atomic energy program as of October 1954. This estimate does not include the personnel of other industries which supplied components for the program.

Mining Activities	Personnel
USSR	150,000 - 200,000
Germany	150,000 - 200,000
Czechoslovakia	15,000 - 25,000
Bulgaria	4,000 - 6,000
Poland	6,000 - 10,000
Romania	4,000 - 8,000
China	2,000 - 4,000
Total	331,000 - 453,000*
Research and Production Activities	
Production	20,000 - 30,000
Research	5,000 - 8,000
Construction	50,000 - 60,000
Total	75,000 - 98,000
Grand Total	406,000 - 552,000

* Of this total, approximately 30% are probably employed in the construction of plants, shafts, housing, roads, etc. directly related to mining activities.

2. Outstanding Personalities

a. Soviet scientists possibly connected with the USSR atomic energy program. Many, if not most, of the Soviet top-level physical scientists participated to some degree even though they may not have been within the atomic energy organization per se. However, the following listing does include those prominent individuals known or presumed to have participated in the Soviet atomic energy effort:

AKHIYEZER, Aleksandr Il'ich, Dr. -- Thermal Engineering Laboratory, Academy of Sciences, USSR, Moscow (1953). Has also been associated with the Ukrainian Physico-Technical Institute and Kharkov State University. Specialty: Theoretical Nuclear Physics. Frequently collaborates with Pomeranchuk. Born 1913.

ALEKSANDROV, Anatoliy Petrovich, Dr. -- Elected Member, Academy of Sciences, USSR (1953). Director, Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR, Moscow (1953). Specialty: Molecular physics and high polymers. Received Order of Lenin (1954). Born 1903.

ALEKSANDROV, Semen Petrovich, Professor. -- Moscow Institute for Non-ferrous Metals and Gold imeni V. M. Kalinin, Moscow (1946). Specialty: Mining Engineering. Was a technical advisor to the Soviet delegate to U.N. Atomic Energy Commission and an observer at Operation Crossroads. Born 1891.

ALEKSANDROVICH, V. A. -- Associated with Laboratory 2 (1954). Institute of Physico-Chemistry imeni L. V. Pisarzhevskiy, Ukrainian Academy of Sciences, Kiev (1942). Specialty: Physical Chemistry. Has worked on isotope chemistry, separation of heavy water and separation of uranium isotopes by thermal diffusion.

ALEKSEYEVSKIY, N. Ye -- Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR, Moscow (1954). Specialty: Low temperature physics and superconductivity.

ALIKHANOV, Abram Isaakovich, Dr. -- Member, Academy of Sciences, USSR. Institute of Physics, Academy of Sciences, Armenian SSR (1954). Believed to be Director of Laboratory 3, Moscow (1947, 1950). Has also been associated with Obninskoye (1950), and the Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR, Moscow. Specialty: Nuclear physics and cosmic rays. Probably one of the key scientists in the atomic energy program. Awarded Stalin Prize 1947 for work on the physics of the atomic nucleus and an Order of Lenin (1954). Brother to Alikhanyan. Born 1904.

ALIKHANYAN, Artemi Isaakovich, Dr. -- Corresponding Member, Academy of Sciences, USSR, who was nominated but not elected Member 1953. Director, Physics Institute, Academy of Sciences, Armenian SSR (1953). Head of a Laboratory, Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR (1953). Holder of a Chair, Moscow Mechanical Institute (1953). Deputy Director of Laboratory 3 (1947, 1950). Associated with Obninskoye (1950) and the Institute of Physical Problems imeni S. I. Vavilov of the Academy of Sciences, USSR, Moscow (1945-1951). Specialty: Nuclear physics and cosmic rays. He directs an active group of scientists doing cosmic ray research on Mt. Alagez in Armenia. Brother to Alikhanov. Born 1908.

ALKHAZOV, Dmitriy Georgiyevich -- Leningrad Physico-Technical Institute, Academy of Sciences, USSR, Leningrad (1953). Was associated with the Cyclotron Laboratory of the Radium Institute imeni V. G. Khlopin, Academy of Sciences, USSR, Leningrad (1947). Specialty: Accelerator research. He was published on isotope separation by linear accelerator and thermal diffusion.

ARTSIMOVICH, Lev Andreyevich, Dr. -- Elected Member, Academy of Sciences, USSR (1953). Professor, Moscow Mechanical Institute, (1953). At Leningrad Physico-Technical Institute, Academy of Sciences, USSR, through 1948. Also associated with research on isotope separation at Sinope. Specialty: Electron physics. Has worked on bremstrahlung, scattering of fast electrons and neutrons, and electron optics. He is an important experimental physicist who has definitely been associated with the atomic energy program. He has received two Orders of Lenin and an Order of the Red Banner of Labor (1954). Born 1909.

BALANDIN, Aleksey Aleksandrovich, Dr. -- Member, Academy of Sciences, USSR, Chief of Laboratory of Organic Catalysis of Institute of Organic Chemistry imeni N. D. Zelinskiy, Academy of Sciences, USSR, Moscow, (1954).

Moscow State University imeni M. V. Lomonosov (1954). Specialty: Organic Chemistry, Heavy Water. Born 1898.

BERESTETSKIY, V. B. Dr. -- Member, Thermal Engineering Laboratory, Academy of Sciences, USSR (1953). Leningrad Physico-Technical Institute, Academy of Sciences, USSR (1946). Specialty: Theoretical nuclear physics, nuclear reactions. Has published actively from the Academy of Sciences. Associated with Pomeranchuk and Landau.

BLAGONRAVOV, Anatoliy Arkad'yevich, Lt. Gen. of Artillery. -- Member, Academy of Sciences, USSR. Deputy Scientific Secretary of the Department of Technical Sciences, Academy of Sciences, USSR (1953). President, Academy of Artillery Sciences (1950). Director, Institute of Machine Studies, Academy of Sciences, USSR, Moscow (1954). Specialty: Armaments and special weapons. Has been associated with the FCD. Born 1894.

BLOKHINTSEV, Dmitriy Ivanovich Dr. -- Corresponding Member, Academy of Sciences, USSR, who was nominated but not elected Member, 1953. Professor, Moscow State University imeni Lomonosov (1953). Has been associated with the Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR, Moscow (1949) and Obninskoye (1950). Has inspected research at Sinope. Specialty: Theoretical nuclear physics, quantum mechanics. An important scientist in the atomic energy program who has done review work on U. S. articles on fission of U-235 and U-233.

BORISOV, N. D. -- Ukrainian Physico-Technical Institute, Academy of Sciences, Ukrainian SSR, Kharkov (1947). Member of Institute of Ferrous Metallurgy, Ukrainian SSR (1947). Located in Ukrainian SSR (1954). Specialty: Experimental nuclear physics. Has worked on particle scattering and counter technique in low concentrate analysis but has not published since 1947.

BRODSKIY, Aleksandr Il'ich, Dr. -- Corresponding member of the Academy of Sciences USSR. Director, Institute of Physical Chemistry, imeni L. V. Pisarzhevskiy, Academy of Sciences, Ukrainian SSR, Kiev (1953). Specialty: Physical Chemistry. Has done work on separation of heavy water. Wrote article (1942) on uranium isotope separation by thermal diffusion. Born 1895.

CHERNYAYEV, Il'ya Il'ich, Dr. -- Member, Academy of Sciences, USSR. Director, Institute of General and Inorganic Chemistry imeni N. S. Kurnakov, Academy of Sciences, USSR, Moscow, (1953). Specialty: Inorganic Chemistry and Metallurgy. Is also chief of Laboratory of Stereo - Chemistry of Complex Compounds of Platinum, of the above Institute. Associated with isotope separation development. Received Order of Lenin (1954). Born 1893.

DOBROTIN, Nikolay Alekseyevich, Dr. -- Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR, Moscow, (1953). Specialty: Nuclear physics, cosmic rays. Delegate to the International Conference of Theoretical Physics (Role of Electron Shells in Radioactive Phenomena) Paris, 1954.

FLEROV, Georgiy Nikolayevich -- Elected Corresponding Member, Academy of Sciences, USSR (1953). Laboratory 2 (1954). Formerly associated with the Leningrad Physico-Technical Institute, Academy of Sciences, USSR. Specialty: Experimental nuclear physics. Shared Stalin Prize 1944 with K. A. Petrzhak for the discovery of spontaneous fission of uranium in Leningrad, 1940. An important atomic energy physicist with no publications since 1942.

FOK, Vladimir Aleksandrovich, Dr. -- Member, Academy of Sciences, USSR. Professor, Leningrad State University imeni Zhdanov (1952). Member, Scientific Council, Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR, Moscow (1950). Delegate to the First Hungarian Physics Conference, Budapest (1953). Delegate to the First Hungarian Physics Conference, Budapest (1953). Specialty: Theoretical physics. Has done work on quantum mechanics, electrodynamics, relativity, and radio waves. Received Stalin Prize in 1947 for theoretical work in atomic physics. Born 1898.

FRANK-KAMENETSKIY, D. A., Dr. -- Laboratory of Kinetics of Photo-Chemical Reactions of the Institute of Chemical Physics, Academy of Sciences, USSR, Moscow (1949). Has given a course at the Moscow Mechanical Institute (1947). Had Moscow address (1954). Specialty: Theory of combustion and explosion Received a prize in 1949 for "Diffusion and Thermal Conductivity in Chemical Kinetics". His recent papers have dealt with astrophysical problems concerned with the oscillations of stars.

FRUMKIN, Aleksandr Naumovich, Dr. -- Member, Academy of Sciences, USSR. In 1949 he resigned his last known position as Director, Institute of Physical Chemistry, Academy of Sciences USSR, Moscow, and as Director, Scientific Research Institute of Physical Chemistry imeni L. Ya. Karpov, Ministry of Chemical Industry USSR, Moscow. Specialty: Physical Chemistry. He is very prominent scientist who has continued publishing since 1949. He might possibly be associated with heavy water research. Born 1895.

GAL'PERIN, Nisson Il'ich -- Professor of Machine Construction, Institute of Fine Chemical Technology, Ministry of Chemical Instustry, Moscow (1949). Specialty: Chemical Engineering. May be an advisor to the atomic energy program, especially on manufacture of chemical equipment.

GERLING, Erikh Karlovich, Dr. -- Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR, Moscow (1950). Associated with the Radium Institute imeni V. G. Khlopin, Academy of Sciences, USSR, Leningrad (1939 - 1948). Specialty: Radiochemistry, geochemistry, and nuclear physics. Has studied the properties of radioactive deposits and fluoro-uranium compounds.

GINZBURG, Vitality Lazarevich, Dr. -- Elected Corresponding Member, Academy of Sciences, USSR (1953). Scientific Council, Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR, Moscow (1952). Specialty: Theoretical physics. A versatile scientist who has published on radiation theory, nuclear physics, cosmic rays, low temperature physics and astrophysics.

GOLOBROD'KO, Timofey A. -- Ukrainian Physico-Technical Institute, Academy of Sciences, Ukrainian USSR, Khar'kov (1949). Specialty: Experimental Nuclear Physics, neutron physics. Has published little since 1945. Born 1898

GOLUBTSOV, Vyascheslav Alekseyevich, -- Elected Corresponding Member, Academy of Sciences, USSR (1953). Director, Moscow Power Engineering Institute imeni V. M. Molotov, Ministry of Higher Education, USSR (1950). Attended World Power Conference in London (1950). Delegate to International Power Conference, Rio de Janeiro (1954). Specialty: Power engineering. May be connected with atomic power plant development. Born c1900.

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GOREMYKIN, Vasiliy Ivanovich, Dr. -- Head of the Department of Special Studies (Otdela Spetsrabot) Academy of Sciences, USSR (1952). Specialty: Chemistry. Has studied complex compounds of platinum group metals. Born c1907.

GRINBERG, Aleksandr Abramovich, Dr. -- Corresponding Member, Academy of Sciences, USSR. Leningrad Technological Institute imeni Lensovet, Ministry of Higher Education USSR, (1953). Former Chief, Chemical Division, Radium Institute imeni V. G. Khlopin, Academy of Sciences, USSR. Specialty: Nuclear Chemistry. A specialist in complex compounds who has not been publishing recently. Born 1898.

GRINBERG, Georgiy Abramovich, Prof. -- Leningrad Polytechnic Institute imeni M. I. Kalinin, Ministry of Higher Education USSR (1953). Leningrad Physico-Technical Institute, Academy of Sciences, USSR (1949). Specialty: Accelerator physics. Worked on electronic instruments, computing devices, and particle accelerators. Received 1948 Stalin Prize Laureate.

GUREVICH, I. I., Prof. -- Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR (1949). Specialty: Nuclear physics and neutron physics. As a member of the Radium Institute, he participated in the early work of Kurchatov's group on nuclear fission. Has written on thermal diffusion and a few recent papers on varitrons.

IOFFE, Abram Fedorovich, Dr. -- Member, Academy of Sciences, USSR. Head of Laboratory of Semi-conductors, Academy of Sciences, USSR (1953). Specialty: Semi-conductors. Chairman of Committee on Semi-conductors, Academy of Sciences, USSR (1954). Former Director, Leningrad Physico-Technical Institute, Academy of Sciences, USSR, who was one of the most prominent and famous Soviet scientists before the War. Born 1880.

IVANENKO, Dmitriy Dmitriyevich, Prof. Dr. -- Professor, Department of Physics, Moscow State University imeni M. V. Lomonosov (1953). Specialty: Theoretical Nuclear physics and field theory. An active publisher who has received a prize for work on theory of bremstrahlung radiation and problems of electrodynamics. Has also worked on meson theory.

KAPITSA, Petr Leonidovich, Prof. Dr. -- Member, Academy of Sciences, USSR. Head of a Laboratory, Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR, Moscow (1954) and former Director until 1946. Former Head of the USSR Atomic Research Committee (1946). Specialty: Physics of low temperatures and high magnetic fields. A physicist of international reputation who worked at Cambridge University 1920-1933 and has had extensive contacts with the West. He is frequently reported to be in disfavor; however, he received an Order of the Red Banner of Labor (1954). Born 1894.

KARGIN, Valentin Alekseyevich, Dr. -- Elected member of the Academy of Sciences, USSR (1953). Chief of the Colloidal Chemistry Laboratory, Scientific Research Institute of Physical Chemistry imeni L. Ya. Karpov, Ministry of Chemical Industry USSR, Moscow, (1953). Associated with Moscow Institute for Fine Chemical Technology and Scientific Research Institute for Plastics imeni Frunze, both of the Ministry of Chemical Industries (1950). Specialty: Physical chemistry, high-polymeric and high-molecular compounds.

KHARITON, Yuliy Borisovich -- Elected Member, Academy of Sciences, USSR (1953). Head of a Section, Institute of Chemical Physics, Academy of Science, to Council of Unions, Supreme Soviet, USSR, from Leningrad (1954). Specialty: Theoretical physics, particularly explosives and chain reactions. Wrote on chain decomposition of uranium in 1940 and was the first to propose atomic pile. Has published nothing sonce. Probably important in weapons phase of atomic energy program.

KIKOIN, Isaak Konstantinovich, Dr. -- Elected Member, Academy of Sciences, USSR (1953). Holder of Chair, Moscow Mechanical Institute (1953). Deputy Director of Laboratory 2 (1947) and associated with it through 1954. Has been associated with research and teaching in Sverdlovsk since 1937. Reported to be interested in isotope separation developments, principally gaseous diffusion, at Agudzeri and Sinope. Specialty: Solid state physics and physics of metals. Has published on galvanomagnetic effect, photomagnetic effect, semiconductors, and low temperatures. Believed to be key scientist in gaseous diffusion development and possibly in the isotope separationsprogram. Received Order of Lenin (1954). Born 1908.

KOMPANEYETS, Aleksandr S., Dr. — Institute of Chemical Physics, Academy of Sciences, USSR (1954). Ukrainian Physico-Technical Institute, Academy of Sciences, Ukrainian SSR (1948). Specialty: Theoretical physics. Has worked on scattering and recently on field theory and meson theory. Works with Zeldovich. Born 1910.

KORSUNSKIY, Mikhail Izrailevich, Dr. — Identified with the Khar'kov Polytechnic Institute imeni V. I. Lenin (1953). Head of a section, Ukrainian Physico-Technical Institute, Academy of Sciences, Ukrainian SSR, Khar'kov (1948). Specialty: Experimental nuclear physics. Has done work on construction of mass spectrographs, ion sources, and high voltage problems. Born c1900.

KRUZHILIN, Georgiy Nikitich — Elected Corresponding Member, Academy of Sciences, USSR (1953). Division Chief, Fine Instrument Laboratory (Laboratory 2) Moscow (1954). Energetics Institute imeni Krzhizhanovskiy, Academy of Sciences, USSR (1949). Specialty: Physics. Expert on heat transfer and boiler installations. May be concerned with nuclear power applications.

KURCHATOV, Boris Vasil'yevich — Identified with the Department of Physico-Mathematical Sciences, Academy of Sciences, USSR (1953). Head of a section, Laboratory 2, Academy of Sciences, USSR, (1945). Chief of the Laboratory of Electric Conductivity of Semiconductors, Leningrad Physico-Technical Institute, Academy of Sciences, USSR (1940). Specialty: Experimental nuclear physicist. Has done work on neutron scattering and semiconductors but has not been publishing. Younger brother of Igor.

KURCHATOV, Igor Vasil'yevich, Dr. — Member, Academy of Sciences, USSR. Member of the Praesidium, Academy of Sciences, USSR (1953). Chief Laboratory of Nuclear Reactions, Leningrad Physico-Technical Institute, Academy of Sciences, USSR (1951). Director of Laboratory 2 (1945). Has also been associated with Laboratory 3. Deputy to the Council of Unions, Supreme Soviet, USSR, from Sverdlovsk (1954). Specialty: Nuclear physics. A top notch nuclear physicist who directed the first Soviet group which studied nuclear fission in Leningrad in 1939-1940. Probably key scientist directing research on reactors and weapons for the atomic energy program. Acknowledged in the Great Soviet Encyclopedia as important in the development of the atomic bomb. Received Order of Lenin (1954). Born 1903.

LANDAU, L'yev Davydovich, Dr. -- Member, Academy of Sciences, USSR, Head of the Department of Theoretical Physics, Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR, Moscow (1953). Specialty: Theoretical physics. A famous and versatile physicist who has worked particularly on low temperature physics and nuclear physics. He has been publishing recently on quantum electrodynamics. Works closely with Pomeranchuk's group.

LANGE, Fridrikh F, Dr. -- Physico-Technical Institute, Ukrainian Academy of Sciences, Khar'kov (1948). Was with the Institute during World War II. Former German engineer turned physicist. Specialty: Experimental physics. Emigrated to USSR in 1935. Has done work in field of particle acceleration.

LATYSHEV, Georgiy Dmitriyevich, Dr. -- Head of a laboratory of the Leningrad Physico-Technical Institute (1949) and associate member of Ukrainian Academy of Sciences. Specialty: Experimental nuclear physics. Has done much work on nuclear radiations, particularly gamma radiations. Born c1908.

LAZAREV, Boris Georgiyevich -- Prof. Physico-Technical Institute, Ukrainian Academy of Sciences, Kharkov. Specialty: Cryophysics. Leader of an active school of low temperature research. Developed method for concentrating Beryllium.

LEBEDEV, Sergey Alekseyevich, Dr. -- Elected Member, Academy of Sciences, USSR (1953). Director, Institute of Precision Mechanics and Computing Technology, Academy of Sciences, USSR, Moscow (1953). Holder of a Chair, Moscow Physico-Technical Institute (1953). Specialty: Computors. Designed and constructed first Soviet high-speed mathematical computor. Born 1902.

LEYPUNSKIY, Aleksandr Il'ich -- Associated with the Leningrad Physico-Technical Institute, Academy of Sciences, USSR (1950). Head of a department, Physics Institute, Academy of Sciences, Ukrainian SSR (1948). Director of research, 9th Directorate of the MVD until c1949, and Director of research at Obninskoye until c1950. Maintained a Moscow address through 1954. Specialty: Experimental nuclear physics. His most recent papers dealt with neutron scattering and nuclear fission in 1939-41. He is reported to have supervised all German research for the Soviet atomic energy program. Worked on radiation and accelerator research at Obninskoye until his transfer because of the reported failure of his research/

LUKYANOV, Stepan Yur'evich, Dr. -- Head of a Division, Fine Instrument Laboratory (Laboratory 2) Moscow (1954). Specialty: Physics. Published on semiconductors in 1939, and nothing since.

MARKOV, M. A., Professor, Dr. -- Elected Corresponding Member of the Academy of Sciences, USSR (1953). Institute of Physics imeni Lebedev, Academy of Sciences, USSR, Moscow (1950). Specialty: Theoretical nuclear physics. Has published a number of papers on nuclear forces, field theory, etc.

MESHCHERYAKOV, Mikhail Grigorevich, Dr. -- Elected Corresponding Member of the Academy of Sciences, USSR (1953). Chief of the Special Laboratory, Radium Institute imeni V. G. Khlopin, Academy of Sciences, USSR, Leningrad, (1947). Specialty: Experimental nuclear physics. Has done considerable work with cyclotrons and has worked in fields of neutron physics and helium isotopes but has not been publishing recently. He was a technical expert to Soviet representative on UN Commission for Control of Atomic Energy (1946) and an observer at Crossroads. Visited US for Princeton 150th Anniversary (1947). Born c1910.

MIGDAL, Arkadiy Benyusovich -- Elected Corresponding Member of the Academy of Sciences, USSR (1953); Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR (1951). Identified with the Leningrad Physico-Technical Institute, Academy of Sciences, USSR, (1948 (?)); Member of the Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR, Moscow, (1945). Maintained a Moscow address through 1954. Specialty: Theoretical nuclear physics. Has done considerable work on cosmic rays, but has published little recently. Born c1914.

MOROZOV, Pavel Matveevich, Dr. -- Head of a Division, Fine Instrument Laboratory (Laboratory 2) Moscow (1954). Specialty: Physics. His papers have dealt with secondary electron emission but he has published nothing since 1946.

MURIN, A. N. -- Radium Institute imeni V. G. Khlopin, Academy of Sciences USSR, Leningrad, (1953). Specialty: Theoretical physics. Has written on separation of isotopes by thermal diffusion and by the cyclotron and linear accelerator. He has been publishing little recently.

NEMENOV, Leonid Mikhaylovich -- Mass spectroscopy Laboratory, Leningrad Physico-Technical Institute, Academy of Sciences, USSR, (1935-1949). Division Chief, Laboratory 2 (1945). Specialty: Mass spectroscopy. Little is known of his current work since he has published nothing since 1939.

NESMEYANOV, Aleksandr Nikolayevich, Dr. -- President of the Academy of Sciences, USSR, (1954); Director of the Institute of Organo-Elemental Compounds, Academy of Sciences, USSR, (1954); Member of the Council of the Union, Supreme Soviet USSR, (1954); Member of the World Peace Council, (1954). Has been Director of Institute of Organic Chemistry, Moscow; Member of Administration Office of Department of Chemical Sciences; and Rector of Moscow State University imeni M. V. Lomonosov (1948). Specialty: Organic chemistry. Specializes in metallo-organic and elemento-organic chemistry. Born 1899.

NIKITIN, Sergey Yakovlevich, Dr. -- Identified with Department of Physico-Mathematical Sciences, Academy of Sciences, USSR (1953); Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR (1945). Had a Moscow address in 1954. Specialty: nuclear physics. Has done work in field of cosmic rays with Alikanyan's group.

NIKITIN, Vasili Petrovich -- Professor; Doctor -- Member of the Presidium of Academy of Sciences, USSR (1953). Specialty: Electro-mechanics. Has done considerable work on electric welding. As acting Secretary of Presidium he controls operation of institutes, has jurisdiction over special projects sections and generally controls assignment of personnel. Born 1893.

NIKOLSKIY, B. P. -- Elected Corresponding Member, Academy of Sciences, USSR (1953). Scientific Council of the Radium Institute, Academy of Sciences USSR (1946). Had a Leningrad address in 1951. Specialty: Radiochemistry. Specializes in theoretical and experimental investigation of ion exchange. Since he has published very little, most of his work has probably been secret.

NOVIKOV, P. S. -- Elected Corresponding Member, Academy of Sciences, USSR (1953). Had a Moscow address (1954). Specialty: computors.

NOVOSELOVA, Aleksandra Vasil'evna -- Elected Corresponding Member, Academy of Sciences, USSR (1953). Moscow State University imeni Lomonosov (1948). Specialty: Beryllium chemistry. Received Stalin prize in 1947 for rare elements. Has published little.

OBREIMOV, Ivan Vasil'yevich, Dr. -- Corresponding Member of the Academy of Sciences USSR, who was nominated but not elected to full membership (1953). Holder of a chair, Moscow Mechanical Institute, Ministry of Higher Education USSR, 1953. Chief of the Optical Laboratory, Institute of Organic Chemistry imeni N. D. Zelinskiy, Academy of Sciences, USSR, Moscow (1953). Member of Scientific Council of Institute of Physical Problems, Moscow (1950), Laboratory 1 (1948). Member of Scientific Council of Institute of Crystallography, Moscow (1946). Specialty: Theoretical physics, chemistry. Has done valuable work in optics and physics of crystals. Born 1894.

PERFILOV, N. A., Professor -- Reportedly a member of the Radium Institute imeni V. G. Khlopin, Academy of Sciences, USSR, Leningrad (1951). Specialty: Experimental nuclear physics. In particular has done research in the application of photographic materials for the detection of elementary particles and uranium fission fragments.

PETRZHAK, Konstantin Antonovich -- Senior scientific associate of the Radium Institute imeni V. G. Khlopin, Academy of Sciences USSR, Leningrad, 1950. Has also been associated with Leningrad Physico-Technical Institute. Specialty: Experimental physics. Notable for his early work on spontaneous fission of uranium for which he has receiyed a prize with G. N. Flerov. Has published nothing since 1941.

POKROVSKIY, Georgiy Iosifovich -- Maj. Gen., Engineering Technical

Service (1954). Member, Academy of Artillery Sciences (1948). Air Engineering Academy imeni Zhukovskiy (1948), Institute of Physical Chemistry. Academy of Sciences, USSR, Moscow (c1948). Specialty: Blast effects and directional explosions. Has written several articles between 1946 and 1954 on such subjects as effects of atomic explosions, directional atomic explosions, and nuclear propulsion.

POMERANCHUK, Isak Yakovlevich, Dr. -- Elected Corresponding Member, Academy of Sciences, USSR (1953). Professor, Moscow Mechanical Institute, Ministry of Higher Education, USSR (1953). Head of a Sector, Thermal Engineering Laboratory, Academy of Sciences, USSR, Moscow (1950). Specialty: Theoretical nuclear physics. Leader of an active group publishing in this field, which is closely allied to Landau's group. Has worked on neutron physics, cosmic rays, accelerators, and nuclear reactions. Born c1920.

PONIZOVSKIY, L. B. -- No specific organization known. In 1943 was at the State Optical Institute. Specialty: Neutron physics, and fission products of uranium. Has been concerned primarily with structure of isotopes. Currently writes for Priroda on nuclear physics.

RATNER, S. B. -- Institute of Chemical Physics, Academy of Sciences, USSR, Moscow (1950). Specialty: combustion and detonation. Has written on detonations, shock waves and photographing explosion waves. Has worked with Khariton and Pokroskiy.

- ROGINSKIY, Simon Zalmanovich, Dr. -- Corresponding Member of the Academy of Sciences, USSR. Holder of a chair, Moscow Institute of Chemical Machine Building, Ministry of Higher Education USSR, (1950). Chief of the Nickel Catalysis Section, Laboratory of Structure of Surface Films, Institute of Physical Chemistry, Academy of Sciences, USSR, Moscow (1950). Specialty: Physical Chemistry. Specializes in catalysis studies and heterogeneous reactions. Has written on the catalytic action of niclel and zinc oxide on hydrogen and deuterium. Born 1900.

RUSINOV, Lo Il'ich, Dr. --Leningrad Physico-Technical Institute, Academy of Sciences, USSR (1951). Identified with the Radium Institute imeni V. G.

Khlopin, Academy of Sciences, USSR, Leningrad (1947). Specialty: Experimental nuclear physics. Interested in nuclear isomerism. Has worked with Kurchatov.

SADOVSKIY, M. A. -- Elected Corresponding Member, Academy of Sciences, USSR (1953). Seismological Institute, Academy of Sciences, USSR (1952). Deputy Director of Scientific part of the Institute of Chemical Physics, Academy of Sciences, USSR, Moscow (1947). Previously Head of Division of Special Work of the same institute. Had Moscow address (1954). Specialty: Blast effects. Received a Stalin Prize in 1947 for determining safe distances of installations from explosions.

SAKHAROV, Andrey Dmitriyevich, Dr. -- Elected Member of Academy of Sciences, USSR (1953). Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR, Moscow (1953). Specialty: Experimental nuclear physics. Has written on cosmic rays, pair production and has published review articles on nuclear physics. No publications since 1949. Born

SEMENOV, Nikolay Nikolayevich -- Member of the Academy of Sciences, USSR. Director of the Institute of Chemical Physics, Academy of Sciences, USSR, Moscow (1953). Member of the Bureau of the Department of Chemical Sciences, Academy of Sciences, USSR (1953). Specialty: Physical chemistry. Well known for work in chemical kinetics and molecular chain reactions. Has done work on combustion and detonations. Born 1896.

SHALYT, S. S. -- Leningrad Physics - Technical Institute, Academy of Sciences, USSR (1954). Associated with Laboratory 2 (1951). Associated with the Ukrainian Physics - Technical Institute 1945. Specialty: Metallurgy and low temperature physics. Has apparently left Laboratory 2.

SHAL'NIKOV, Aleksandr Iosifovich, Dr. -- Corresponding Member, Academy of Sciences, USSR, who was nominated but not elected member (1953). Professor of Moscow State University imeni M. V. Lomonosov (1953). Chief of a laboratory, Institute of Physical Problems imeni S. I. Vavilov, Academy of Sciences, USSR, Moscow (1953). Chief of Laboratory of Molecular Physics of Institute of Chemical Physics, Academy of Sciences, USSR, Moscow (1950). Specialty: Experimental physics. Has specialized in low temperature work and superconductivity

SHCHELKIN, K. I. -- Elected Corresponding Member of the Academy of Sciences, USSR (1953). Institute of Chemical Physics, Academy of Sciences, USSR, Moscow (1954). Specialty: Combustion and detonation of gases. Has published little in recent years.

SHCHERBAKOV, D. I. -- Elected Member of the Academy of Sciences, USSR (1953) and Academician Secretary of the Department of Geological - Geographic Sciences, Academy of Sciences, USSR. Head of a Division, Institute of Geological Sciences, Academy of Sciences, USSR, Moscow (1953). President, Commission on Problems of the North, Academy of Sciences, USSR (1954). Specialty: Geochemistry. Specializes in the geology, mineralogy, geochemistry of rare elements. Was a member of the Commission on the Uranium Problem of the Academy of Sciences, USSR, (1940). Has not been publishing. Received Order of Lenin (1954). Born 1893.

SHUBNIKOV, Aleksey Vasil'yevich, Dr. -- Elected Member, Academy of Sciences, USSR (1953). Director, Institute of Crystallography, Academy of Sciences, USSR (1953). Professor, Moscow State University imeni M. V. Lomonosov (1953). Deputy Academician Secretary, Department of Physico-Mathematical Sciences, Academy of Sciences, USSR (1953). Specialty: Crystallography, physics of crystals. Internationally known. Received Order of Lenin (1954). Born 1887.

SIMONENKO, Danil Lukich -- Division Chief, Fine Instrument Laboratory (Laboratory 2), Moscow (1954). Associated with the Institute of Physics of Metals, Urals Affiliate of the Academy of Sciences, USSR. (1945- 1950). Specialty: Physics. Has worked on mass spectrographs, moleculear beams and the physics of metals, but has published little.

SINEL'NIKOV, Kirill Dmitriyevich, Dr. -- Active member of the Academy of Sciences, Ukrainian SSR who was nominated but not elected member, Academy of Sciences, USSR, (1953). Director, Ukrainian Physico-Technical Institute, Academy of Sciences, Ukrainian SSR, Khar'kov (1953). Holder of a chair, Khar'kov State University imeni A. M. Gor'kiy, Ukrainian SSR (1953), Laboratory 1 (1948). Specialty: Experimental physics. Has done extensive experimental work on the construction and use of particle accelerating devices. He has not been publishing. He has studied in England and has an English wife. Born 1900.

SKOBELTSYN, Dmitriy Vladimirovich, Dr. -- Member, Academy of Sciences, USSR, Director, Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR, Moscow (1953). Moscow State University imeni M. V. Lomonosov (1953). Deputy to Council of Unions, Supreme Soviet USSR (1953) and member of Foreign Relations Committee. Chairman, International Stalin Peace Prize Committee (1954). Head of Soviet delegation to the Internation Conference on Theoretical Physics (Role of Electron Shells in Radioactive Phenomena), Paris (1954). Specialty: Experimental nuclear physics. Particularly cosmic rays. As well as being an important scientist, he has been chief Soviet scientist involved in international discussions of atomic energy in his positions as Technical Advisor to Gromyko and Soviet Representative on Scientific and Technical Committee of UN in 1946. Received Stalin Prize 1950 for work in cosmic rays and an Order of Lenin in 1954. Born 1892.

SMORODINSKIY, Yakov Abramovich, Prof., Dr. -- Division Chief, Fine Instruments Laboratory (Laboratory 2), Moscow (1954). Institute of Physical Problems, Academy of Sciences, USSR, Moscow (1945). Specialty: Theoretical nuclear physics, quantum mechanics. Has been concerned with particle scattering and spectral isotopic shift. Has only published a few papers in recent years.

SOBOLEV, Sergey Lvovich, Dr. -- Member of the Academy of Sciences, USSR; Member of the Mechanics Division, Mathematics Institute imeni V. A. Steklov, Academy of Sciences, USSR, Moscow (1951). Chief of Sector Laboratory 2 (1945) and reported Director in 1947. Specialty: Mathematics, differential equations of physics. A very prominent and active mathematician. Received Order of Lenin (1954). Born 1908.

STARIK, Iosif Yevseyevich, Dr. -- Corresponding Member of the Academy of Sciences, USSR who was nominated but not elected member (c1953). Deputy

Director, Radium Institute imeni V. G. Khlopin, Academy of Sciences, USSR Leningrad, (1953). Specialty: Radiochemistry and geochemistry. Has written on the occurence of radioactive elements, but has published nothing since 1947. Was at Wismut A. G. in 1948 and returned to USSR in mid-1949.

STRELKOV, P. G., Prof -- Institute of Physical Problems, Academy of Sciences, USSR, Moscow (1954). Specialty: Experimental low temperature physics. Has published very little, but appears to be concerned with thermometry and engineering at low temperatures. Occupied post of Inspector, Soviet Purchasing Commission, N.Y. in U.S. from 16 December 1944 to 30 June 1945.

SYRKIN, Yakov Kivovich -- Corresponding Member of the Academy of Sciences, USSR. Chief of the Laboratory of the Structure of Matter, Scientific Research Institute of Physical Chemistry imeni L. Ya. Karpov, Ministry of Chemical Industry USSR (1950). Specialty: Physical chemistry. Reported to be working with heavy water. Has done work in field of molecular structure. Born 1894.

TAMM, Igor Yevgen'yevich, Dr. -- Elected member of the Academy of Sciences, USSR (1953). Head of a division, Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR (1953). Holder of a Chair, Moscow Mechanics Institute, Ministry of Higher Education USSR (1950). Specialty: Theoretical nuclear physics. Has published occasional recent papers on quantum theory and cosmic rays. Received Order of Lenin (1954). Born 1895.

TERLETSKIY, Yakov Petrovich, Dr. -- Director of an observation station concerned with natural radioactive phenomena and high-altitude cosmic rays located near Sochin, RSFSR (1953). Holder of the Chair of Physics, Moscow State University imeni M. V. Lomonosov (1952). Specialty: Theoretical physics. Has written papers on the betatron and quantum mechanics. Has done theoretical work on induction accelerators and the origin of cosmic rays.

TIMOSHUK, Dmitriy Vladimirovich, -- Division Chief, Fine Instruments Laboratory (Laboratory 2), Moscow (1954). Formerly associated with the Ukrainian Physico-Technical Institute, Academy of Sciences, Ukrainian SSR, Kharkov (1944).

Specialty: Nuclear physics. His most recent publications dealt with neutron physics (1939-1940). He may be connected with reactor development.

TSEKERMAN, Veniamin Aronovich -- Scientific Research Institute of the Soviet Air Force (1946), Institute of Machine Studies, Academy of Sciences, USSR, Moscow (1946). Had Moscow address 1954. Specialty: Physics. Has specialized in x-ray photography of explosion and detonation processes. Has published nothing since 1946.

VAL'TER, Anton Karlovich, Dr. -- Member, Academy of Sciences, Ukrainian SSR who was nominated but not elected member of the Academy of Sciences, USSR (1953). Deputy Director of the Ukrainian Physico-Technical Institute, Academy of Sciences, Ukrainian SSR, Khar'kov (1953). Holder of a chair, Khar'kov State University imeni A. M. Gor'kiy, (1953). Laboratory 1 (1948)1 Specialty: Experimental nuclear physics. Has done work on high voltage particle accelerators but has published nothing since 1940.

VASIL'YEV, Mikhail Fedorovich, Dr. -- Lt. Gen of Artillery. Member, Academy of Artillery Sciences, Chief of Faculty of Ammunition, Artillery Academy imeni F. E. Dzerzhinskiy, Moscow (1946). Specialty: Ordnance. Interested in theory of armaments.

VEKSLER, Vladimir Iosifovich, Dr. -- Corresponding Member of the Academy of Sciences, USSR who was nominated but not elected member (1953). Head of a laboratory, Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR, Moscow (1953). Holder of a chair, Moscow State University imeni M. V. Lomonosov (1953). Has Moscow and Leningrad addresses. Specialty: Experimental nuclear physics. Specializes in accelerators and cosmic rays and is noted for the development of the synchrotron. Has been publishing little.

VERNOV, S. N., Dr. -- Elected Corresponding Member of the Academy of Sciences, USSR (1953) Physics Institute imeni P. N. Lebedev, Academy of Sciences, USSR, Moscow (1949). Professor, Moscow State University imeni M. V. Lomonosov (1948). Specialty: Nuclear physics, cosmic rays. Active in cosmic ray expeditions to the Pamirs. Stalin Prize (1949) for cosmic ray research.

VINOGRADOV, Aleksandr Pavlovich, Dr. -- Elected Member, Academy of Sciences, USSR (1953). Director, Institute of Geochemistry and Analytical Chemistry imeni Vernadskiy, Academy of Sciences, USSR, Moscow (1953). Holder of a Chair, Moscow State University imeni M. V. Lomonosov (1953). Deputy Academician Secretary, Department of Chemical Sciences, Academy of Sciences, USSR (1953). Specialty: Geochemistry. Has specialized in the geochemistry of rare elements and received a Stalin Prize (1950) for "Geochemistry of rare and dispersed Chemical elements in the soil", and an Order of Lenin (1954). Elected to Bureau of the Department of Chemical Sciences (1949) in the field of nuclear energy. Born 1896.

ZAVOYSKIY, Yevgenniy Konstantinovich -- Elected Corresponding Member of the Academy of Sciences, USSR, (1953). Division Chief, Fine Instruments Laboratory (Laboratory 2), Moscow (1954). Kazan State University (c1949). Specialty: Physics, paramagnetism. Has not published since 1947.

ZEL'DOVICH, Yakov Borisovich, Dr. -- Corresponding Member, Academy of Sciences, USSR, who was nominated but not elected member (1953). Head of a Division, Institute of Chemical Physics, Academy of Sciences, USSR, Moscow (1953). Specialty: Physical chemistry and theoretical physics. Well known for work on theory of flame propagation and detonation in gases and explosives. Worked with Khariton in 1939 and 1940 on chain reactions in uranium and has been publishing recently on theoretical nuclear physics.

ZHDANOV, Aleksandr Pavlovich -- Radium Institute imeni V. G. Khlopin, Academy of Sciences, USSR, Leningrad (1954). Specialty: Experimental nuclear physics, cosmic rays. Major interest in nuclear fission in cosmic rays. Has done meson research by means of photo-emulsion method.

3. Deceased Scientists

The following Russian scientists listed in the previous NIS, died on the dates indicated:

Akimov, Georgiy Vladimirovich	March 1953
Andronov, Aleksandr Aleksandrovich	November 1952
Frenkel, Yakov Il'ich	23 January 1952

Khlopin, Vitaliy Grigor'yevich	10 July 1950
Lukirskiy, Petr Ivanovich	18 November 1954
Mysovskiy, Leo Vladimirovich	1939
Nikitin, Boris Aleksandrovivh	20 July 1952
Slutskin, Avram Aleksandrovich	14 July 1950
Vavilov, Sergey Ivanovich	27 January 1951
Vosnezenskiy, Ivan Nikolayevich	1946

4. German Scientists

The previous NIS listed 37 German scientists which were thought to be working on the Soviet atomic energy program. It is now thought that these German scientists have been removed from any work pertaining to the program and are now awaiting their return to Germany. Many of the PW scientists and technicians have been returned. Gustav Herts has been returned to East Germany and the other scientists are expecting to return in the near future.

F. Research Facilities

The development of the Soviet atomic energy program has been based on a major Soviet research effort in many fields of science and engineering. This is a very complex effort which has been carried out at a large number of installations protected by a high degree of security. As a result, although there is a great deal of information relating to certain phases of the research program, out knowledge of the program as a whole is severely limited.

Research for the early development of the program was carried out in the Academy of Sciences of the USSR, first in the major institutes and later primarily in three special laboratories established expecially for atomic energy development. Additional specific research projects for the atomic energy program were carried out at six installations staffed by German scientists and at numerous factories and institutes subordinate to the various ministeries. As secure research sites bacame available at major atomic energy installations, the most critical research was probably moved to these sites. This gradual transfer was accompanied by a corresponding decrease in informatioh on Soviet research for the atomic energy program.

More is known about research on isotope separation for the Soviet atomic energy program than about any other phase of atomic energy research. Several institutes were engaged in a major effort to develop various methods of isotope separation, particularly gaseous diffusion. The gaseous diffusion research was apparently concentrated at Laboratory 2 with many other institutes contributing research on special projects. As an example of the size of the effort, it is interesting that at least six installations, Laboratory 2, Elektrostal, Sinope, Agudzeri, Chapaevsk, and the Institute of General and Inorganic Chemistry imeni Kurnakov participated in development of barriers for the gaseous diffusion process. Considerably less is known about Soviet research on reactors, and it is only possible to identify some of the major institutes and individuals engaged in reactor development. Laboratory 2 and the Radium Institute appear to have been key research installations in the early development of the reactor program; and we know that Germans at Obninskoye and Zaali also worked on problems related to plutonium production. However, there is little information on more advanced phases of reactor research. Because of the extraordinary security, there is practically no information on Soviet research on atomic weapons, although it is possible to determine some of the personnel and institutes which may have contributed to early weapons development.

1. Special Laboratories of the Academy of Sciences

(a). Laboratory 1, Khar'kov

Little is known about this laboratory which is staffed from the Ukrainian Academy of Sciences. Before the war, Khar'kov ranked with Leningrad as a center of nuclear physics research; so presumably the laboratory continues its nuclear physics tradition.

(b). Laboratory 2, Moscow

Laboratory 2, which is located in newly built facilities west of Serebriann Bor railroad station in Northwest Moscow, was probably the key laboratory in the early development of the Soviet atomic energy program. It was directed by I. V. Kurchatov in 1945, and its staff includes some very prominent Soviet nuclear physicists. It has been concerned with Soviet reactor development and was probably the key laboratory in the development of gaseous diffusion isotope separation. It may have worked on electromagnetic isotope separation and is rumored to be concerned with the nuclear physics of atomic weapons. It has had connections with cosmic ray research and with the laboratories at Sukhumi. It may now be known as the Mine Instrument Laboratory.

(c). Laboratory 3, Moscow

Laboratory 3 was originally in Cheremushki in southern Moscow. It is rumored to have been headed by A. I. Alikhanyan prior to 1950, and through him to have had connections with the cosmic ray research at Mount Alagez in the Caucasus.

2. Laboratories Subordinate to the Ministry of Medium Machine Building

(a). Scientific Research Institute 9 (NII-9)

This institute, located just south of Laboratory 2 of the Academy of Sciences, is responsible for developing the processes connected with the concentration of uranium ores from all types of ore bodies and with the extraction of pure uranium salts from these concentrates. It is also responsible for developing and implementing the analytical control of processes in the extraction of uranium ores. Possibly is concerned with analytical control procedures at later stages in the program.

(b). Research Laboratories formerly under the Ninth Directorate of the MVD.

These laboratories were turned over to the FCD upon the dissolution of the Ninth Directorate in 1949-1950. We have little or no information on their role in the post-1950 period, but in view of facilities installed at these laboratories by 1950 it is probable that they conduct the same lines of research instituted at them in 1946.

1. Sinop near Sukhumi

This Laboratory, whose German chief was Baron Manfred Von Ardenne, was devoted to isotope separation research. Porous nickel barrier for use in a gaseous diffusion process was developed here. Work was done on developing an ion source for the electromagnetic method of isotope separation; and extensive development was doen on the wartime German ultra centrifuge for separation of uranium isotopes. The laboratory also developed, and helped put into production, units for production of fine nickel powder to be used in the porous barrier by the carbonyl method. Significant research at this laboratory has apparently ceased, and its German staff is anticipating an early return to East Germany.

2. Agudzeri near Sukhumi

This Laboratory, whose German chief was Professor Doctor Gustav Hertz, worked both on isotope separation and on instruments for the analytical control of production isotope separation facilities. Apparently unsuccessful research was done on a diffusion method involving UF_6 and fluorocarbons. An apparatus designed to draw air from operating gaseous diffusion cascades was developed here; research was conducted on a continuous method of forming barrier for gaseous diffusion plants which is thought to have since been put into production; and mass spectrometers and radiation counters for the analytical control of isotope separation plants were designed here and later placed into production. Significant research at this laboratory has apparently ceased, and its German staff is anticipating an early return to East Germany.

3. Obninskoye

This installation located some 60 miles southwest of Moscow, was engaged in research on nuclear reactor problems under its German chief, Dr. Heinz Pose. Work was also done here on the nuclear characteristics of both graphite and beryllium oxide moderators. Apparently measurements were also made of the deformation caused in various substances upon irradiation in nuclear reactors. The full scope of the work of this laboratory is not known.

4. Elektrostal

This laboratory, originally headed by the German national, Dr. Nikolaus Riehl, solved in 1946 the problem of producing adequately pure and dense uranium metal. It probably worked on the problem of producing super-purity uranium salts. Work was also done on the production of adequate fluorescent materials for cathode ray tubes and probably on other types of metallurgical research in the atomic energy program. Considerable research and development on gaseous diffusion barriers was carried out at Factory 12.

5. Singul

This laboratory near the towns of Kasli and Kyshtym was not started until late 1947. It started to work on the health physics problems resulting from the irradiation of living tissue by neutrons and gamma rays. Work was also proceeding on a method for separating rare earths, probably in connection with the problem of separating uranium from the various fission products produced in nuclear reactors. It is possible that this laboratory has taken over the work of the preparation of radioactive isotopes extensively used as a research tool in the USSR but its activities may have changed with the removal of most of the Germans in 1952.

6. Serebryanny Bor

It is known that a German research group under the leadership of Dr. Max Volmer was located in the Laboratory 2 area and was working on one of the methods of producing heavy water. Little else is known about either this group or its facilities.

(c). Facilities at Operating Bases

Each operating base or combine of the Ministry of Medium Machine Building, if it is of any size at all, possesses laboratory facilities used in connection with the analytical control of the operations of the combine. These laboratories also perform some research on local problems, but cannot be considered major research facilities.

3. The following are institutes which are known to have carried out specific research problems for the atomic energy program. It is to be noted that this research not only fits into the normal work of these institutes but that the specific research problems detected normally engaged only a small part of the total facilities and personnel available to the institute.

(a) Institutes of the Academy of Sciences

1. The Leningrad Physico-Technical Institute, Academy of Sciences, USSR, Sosnovka Ulitsa 2, Leningrad 21 -- This Institute is one of the oldest and originally best-equipped physical research organization in the USSR and did much of the orignal Soviet work on nuclear fission. Nuclear physics is a major field of interest at the Institute. It possesses a cyclotron and a number of small electrostatic generators, and is staffed with a large number of able theoretical and experimental physicists.

2. The Radium Institute, Academy of Sciences, USSR, Roentgena Ulitsa 1, Leningrad -- Established in 1921, the Radium Institute conducts research on problems related to the production of fissile materials, including the detection of radioactive ores, experimental work with radio-elements, and aspects of plutonium chemistry. Until at least 1945 this was the only institute in the USSR possessing an operable cyclotron, and this has been in continuous use since that time.

3. The Institute of Physics imeni P. N. Lebedev, Academy of Sciences, USSR, Tret'yaya Miusskaya Ulitsa 3, Moscow -- This Institute is one of the more important participants in the research program on atomic energy.

The Laboratory of the Atomic Nucleus is subordinate to this Institute.

4. The Institute of Physical Problems, Academy of Sciences, USSR, Kalushskoe Shosse 32, Moscow -- This Institute was formerly under the direction of the famous physicist Petr L. Kapitsa and concentrated principally upon low temperature physics and high-intensity magnetic fields. It has outstanding workers both in theoretical nuclear physics and low temperature physics, and between 1945 and 1951 it was associated with Alekhanyan's Chemical cosmic ray group. Its associations with the Institute of Chemical Physics and Laboratory 3 and its continued prominence in the Soviet scientific scene suggests that it may have made significant contributions to the program.

5. The Power Engineering (or Energetics) Institute imeni G. M. Kushdishanovskiy, Academy of Sciences, USSR, Bol'shaya Kalushskaya Ulitsa 19, Moscow -- In addition to more ordinary lines of work, the Institute is engaged in research on "new sources of energy" and is also developing high-voltage equipment for particle accelerators and computing apparatus. It may well have a part in the design of nuclear reactors for the production of power.

6. The Institute of Chemical Physics, Academy of Sciences, USSR, Vorobvevskoye Shosse 2, Moscow -- This Institute has had a continuing interest in the theory of explosive chain reactions and has cooperated with the Institute of Physical Problems in their experimental measurements. The first papers on the theory of nuclear chain reactions published in the USSR were written at this Institute in 1939 by Yu. B. Khariton and others. Many of its members have been publishing recently on nuclear physics. It is possible that important research for the project in physical chemistry and in weapon design may be carried out here.

7. The Institute of General and Inorganic Chemistry imeni N. S. Kurnakov, Academy of Sciences, USSR, Bol'shaya Kaluzhskaya Ulitsa 31, Moscow. -- The Kurnakov Institute may be expected to continue to make significant contribution in many fields of conventional chemistry related to

the atomic energy program. In 1947 it was reported to have tested barrier materials for Laboratory #2.

8. Institute of Physical Chemistry, Academy of Sciences, USSR, Bol'shaya Kalushskaya Ulissa 31 Moscow -- This Institute, until 1945, was known as the Colloido-Electro-Chemical Institute. It is engaged in the study of special corrosion problems, and may also have worked on isotope-separation processes.

9. The Institute of Physical Chemistry imeni L. V. Pisarzhevski, Ukrainian Academy of Sciences, Kiev -- This institute was concerned in the very early Soviet research on isotope separation and was important in developing the Soviet heavy water program. Its staff, under A. I. Brodski, specialised for several years prior to the war in the study of stable isotopes and methods of separating them. The first known production of heavy water in the USSR was carried out by this Institute at the Dnepr Dam in 1939. It has published much since the war on the chemical reaction rates of deuterium-containing compounds.

10. The Physico-Technical Institute, Ukrainian Academy of Sciences, Yumanovsky Tupik Kar'kov 24 -- This Institute specialized before the war in the physics of low temperatures and high voltages, constructed a number of particle accelerators and did some research on neutron physics. Evacuation to Alma-Ata during the war caused a dislocation of this activity, but since 1945 the Institute has been re-staffed and re-equipped. It has continued post war research in nuclear and low temperature physics.

11. The Institute of Geochemistry and Analytical Chemistry imeni V. I. Vernadskiy, Academy of Sciences, USSR, Staromonetny Pereulok 33/35, Moscow -- This Institute was formed from the Geochemical Laboratory imeni V. I. Vernadskiy in 1949. It works on problems of the origin and occurrence of radioactive elements, and has pioneered in mass-spectroscopy techniques for determining the conditions of formation of ore deposits.

(b) Institutes subordinate to Ministries.

1. Moscow Engineering Physics Institute (probable new name

of Moscow Mechanical Institute) Ulitsa Kirova 21, M. Pionerskaya 12, Moscow. The function of this pedological Institute, which is subordinate to the Ministry of Culture, is not known precisely but it is considered significant that a number of leading scientists known to be working for the AE program were nominated for election to the Academy of Sciences in 1953, as professors at this Institute. The Institute is probably a high-grade training center for engineering-physicists, but research is conducted, at least to a small degree, in connection with the fulfillment of degree criteria.

2. The Power Engineering (Energetics) Institute imeni Molotov Krasookazasmennays Ulitsa 17, Moscow -- The division of responsibility between this institute and the Kuzhishanovsky Institute is not known. The Molotov Institute is reported to be working on atomic energy problems.

3. The Physico-Chemical Institute imeni L. Ya. Karpov, Ministry of Chemical Industry, Obukha Ulitsa 10, Moscow -- This Institute has done work on the enrichment of deuterium in water by several methods including a combination water electrolysis and catalytic exchange method.

4. State Institute for Rare Metals (Giredmet), Topolev Pereulok 1, Moscow. This institute conducts research on concentration of rare metal ores and production of rare metals, including thorium and possibly uranium. Much of the work of this institute in the postwar period has had application in the atomic energy program.

(c) The following are design organizations which have been concerned with AE problems.

1. State Institute for Planning Nitrogen Enterprises, Chkalova Ulitsa 50, Moscow -- Though the detailed activities of this Institute are not known, it is certain it designed those large-scale heavy water production installations located in a number of synthetic nitrogen plants in the USSR.

2. State Institute for Planning Rare Metals Undertakings, 17 Ba'shaya Cheskasskaya/17 Maroseyka, Moscow -- This Institute, known as "Giproredmet", designs mines and concentrating plants for production of fare metals, including thorium and uranium.

3. Various scientific research institutes of the Chemical Machine Building Industry -- At least three of these scientific research institutes are known to exist, one in Moscow, one in Leningrad and one in Kharkov. Their function is apparently the design of non-standard equipment for the chemical industry, and as such they may be assumed to be of importance in the engineering phases of the Soviet atomic energy program.

G. Industrial Support

1. Industrial Program

An industrial program of the complexity and size of the atomic energy project in the United States or in the USSR requires extensive and close coordination of the activities of a large cross section of the industries of the nation. One listing of the industrial firms making appreciable contributions to the Manhattan Project contained 92 names and, with but few exceptions, participation in this project was confined to the United States.

The Soviets, however, were able to draw on the resources of Western countries, in addition to Eastern Germany and the satellite nations. Although the flow from the West has since been greatly curtailed, the Soviets were able to obtain a considerable amount of strategic material before effective restrictions were imposed. Still, taking into account all these contributions from the outside, the effect on Soviet domestic industry of supplying the demands of the atomic energy program must have been much greater than the effect on industry in the United States. Support for this assumption appears to exist, particularly in view of the great difference in the industrial capabilities of the two nations.

2. Equipment Supply

The bulk of the equipment required in the production of atomic weapons is standard and could be supplied by any of a large number of factories in the USSR. Much of the chemical equipment was produced by plants controlled by the Ministry of Machine and Instrument Building. Examples of such plants are as follows:

Urals Chemical Machine Building Factory (URALKHIMASH), Nizhne-Isetskiy, near Sverdlovsk,

Chirchik Chemical Machine Building Factory imeni Frunze, Chirchik,

Bolshevik Chemical Machine Building Factory, Kiev,

Krasny Oktyabr Chemical Machine Building Factory, Rastov,

Frunze Chemical Machine Building Factory, Sumy,

Borets Pump Factory, Moscow,

In addition, the following firms are capable of making a significant contribution:

Kalinin Machine-Building Factory, Moscow -- manufactures special pumps and precision instruments.

Electro-Turbine Plant, Kheta Works, Khar'kov -- manufactures power turbines, control equipment, relays, etc.

Urals Electrical Equipment Combine -- makes miscellaneous heavy electrical equipment and switch gear.

Elektrosila Zavod, Leningrad -- makes large magnets, heavy electrical equipment.

3. Industrial Contribution from without the USSR

The following are examples of the utilization of industry outside of the USSR:

It is probably that most of the nickel wire mesh for use in gaseous diffusion separation plant was, until the end of 1952, produced by East German factories. The nickel wire for the aforementioned screens, as well as the looms used to weave it, are also products of East German firms.

The former I.G. Farben Plant at Bitterfeld, now called the Elektrochemisches Kombinat, Bitterfeld, has supplied a large fraction of the calcium used in the reduction of uranium to metal for use in the piles.

It is also believed that much of the equipment for the isotope separation program has been obtained from the satellite countries and possibly Switzerland.

H. Sources and Production of Basic Materials

1. Uranium Supply

Current internal mining operations provide about one third of the estimated annual uranium production available to the USSR. The remaining two thirds are obtained from Germany, Czechoslovakia, Bulgaria, Romania, Poland, and China. Of these latter sources, Germany and Czechoslovakia are outstanding in that they provide almost 90 per cent of the total produced outside the USSR.

From geological studies it is estimated that the uranium ore reserves available to the Soviet Bloc will support the present production rate for 30 years if only moderate grade ores are utilized and for another 200 years if low-grade ores such as shales and phosphorites are utilized. At present only a small part of the total production is from the low-grade resources. Most of the reserves lie within the USSR, and probably a large part of the moderate grade reserves within the USSR remain undiscovered. Continued production at a high rate for many years will depend on the continuation of the intensive prospecting program engaged in heretofore by the Soviet atomic energy program, as well as research into efficient recovery methods for low-grade ores.

Except for a few select locations such as those in Germany, Czechoslovakia, and southwestern Siberia, many of the uranium deposits available to the Soviets are uneconomical by American standards, in terms of ore grade or in terms of accessibility. By extensive exploitation of the more favorable deposits, however, the Soviets have succeeded in producing sufficient uranium to support a large atomic energy program. Production in appreciable quantities materially increased after 1950 when the extensive exploration and development of the known uranium ore deposits and research on uranium extraction began to show results.

a. USSR Sources

(1) Ore deposits -- During the early 1930's uranium ore was being mined for recovery of radium in the Fergana Valley, Southwestern Siberia. During World War II uranium mining in the Fergana Valley was separated from other non-ferrous mining activities by the organization of Combine 6. In

late 1945, Combine 6 was placed under the control of the newly formed First Chief Directorate attached to the Council of Ministers, which was made responsible for the Soviet atomic energy program. An extensive uranium prospecting program also started in late 1945 and embraced all parts of the USSR. Under that program, the Fergana expedition discovered numerous additional radioactive deposits in southwestern Siberia, and subsequent expeditions found other deposits at other locations in the USSR.

At the present time, the Fergana Valley and Western Tien Shan Mountain area is believed to be the only highly uraniferous province in the USSR, and is the most important producing region. The Fergana Valley includes important mining locations such as: Fergana, Tyuya-Muyun, Uigar-Sai, Maily-Su, Chust, and Osh. Adjacent to this area is the Kara Mazar Range where uranium deposits are being exploited at sites such as Taboshar, Adrasman, and Kansai. The sources in the Fergana Valley consist of Tyuyamunite and carnotite deposits similar to those of the Colorado Plateau, whereas the Kar Mazar deposits are of the polymetallic fissue-vein type in which primary and secondary uranium minerals are associated with other minerals. Combine 6 operations have expanded several times in these two areas and other, similar, areas nearby have been developed by the Combine with the result that production has continually increased since 1946. These deposits will continue to be important producers for a number of years.

Other uranium deposits in the USSR being exploited by the Soviets are:

Kara Tau Area -- these are small oxidized deposits of minor importance. Production, which started in 1947, has increased rapidly.

Estonia-Slantsi -- The uranium in Estonia and around Slantsi, Leningrad Oblast, USSR, is contained in the Dictyonema shale, which underlies the oil-rich Kukersite shale. The uranium content of the shale is very low; at least 100,000 tons of shale must be processed to produce from 9 to 13 tons of uranium. The Soviets began operations in Estonia in 1947, but production, if any, did not start until the last half of 1948. Actual production appears to be quite small and little pressure has been placed on the project. However, the uranium reserves in the Dictyonema shale is large, and production could reach a few hundred tons of uranium a year if great effort and cost were expended.

Ural Mountains -- Numerous pegmatites in the Urals are mined for beryl, feldspar, and tantalum-niobium minerals. Small pockets and fissures containing uranium minerals are often found in the pegmatites, and recovery of the uranium minerals may be by hand-sorting or by magnetic or electrostatic separation. Uranium ore production at the Ti-rich iron ore mines of Magnitka may be by separation of Dairdite. Production of uranium ore, which may have started in the Urals in 1947, is not great, but could continue at a very low rate for many years.

Karelia and Kola Peninsulas -- Uranium minerals associated with the pegmatites and alkalic igneous rocks in these areas which may be recovered as a by-product from the feldspar industry. Some direct mining of small deposits for the uranium ore may also be under way. The production rate from such areas is very small and of minor importance.

Caucasus -- Little is known about specific uranium deposits in this area, which may be a mildly uraniferous province: uranium is reported in a variety of deposits, including polymetallic veins of the northern Caucasus and carnotite deposits in the southern Caucasus. A processing plant has been identified at Mineralnye Vodi which handles local ores.

A Soviet geological expedition explored the Caucasus for uranium deposits in late 1946 and early 1947. Development work at some of the deposits was started in 1947 and uranium ore production may have started by the end of the year. Uranium mining operations have been reported at Pyatigorsk, at Erevan, and in the vicinity of Mount Elbrus. The present production rate from Caucasus ores is not believed to be large and may increase only slightly in the future.

Eastern Siberia -- Uranium is being produced in a number of areas in eastern Siberia. Many of the uranium deposits were located in or near existing mines, but some have been revealed by post-World War II prospecting expeditions. Some of the deposits are in the "Dalstroy" gold-producing areas along the Kolyma River; another deposit lies just south of Aldan; still others are on the Chukotsk Peninsula in far north eastern Siberia. It is believed that intensive exploitation of these deposits began in 1949, and that, although some production may have occurred that year, the mining operations expanded to their present level by 1953.

Transbaikal -- Soviet mining operations for uranium began in the Transbaikal area in mid-1947. Progress was slow and it is believed that there was much production before 1949. The production rate is moderate, and probably will not increase in the future. Little is known of these deposits, although it is suspected that they are polymetallic veins.

Minusinsk Basin and Tannu Tuva -- Radioactive deposits have been known in the Minusinsk Basin since the 1920's. The reserves are large, but principally in very low-grade deposits which are probably not being mined for uranium. Little is known of the Tannu Tuva deposits; it is suspected they consist of low-grade sandstone-type ores. Production may have begun in late 1949. There is little evidence that this area has developed into an important source of uranium such as the Fergana region.

Others -- Other locations in the USSR where uranium prospecting and mining have been reported are: the Ukraine; the Taymyr Peninsula; Severnaya Zemlya; the Pechora River Basin; the Karaganda area; Lake Balkhash; and the Altai Foothills. Very little is known about the rate of production of uranium ore from these areas, but few of them are likely to be important producers in view of the low grade and small reserves. An exception to this is the Pechora Basin, in which the deposits may be moderate grade sandstones or possibly polymetallic veins.

(2) Operations -- Very little is known of the handling, concentration, and grade of uranium ore at mining locations in the USSR. All indications are that uranium mining operations are somewhat similar to those employed in Germany; counter-sorting of rich vein-ore into boxes at the mine; and chemical or mechanical concentration nearby to a grade of about 1 to 2 percent uranium before being shipped to a refining plant.

b. German Sources

(1) Ore deposits -- Deposits in the Soviet Zone of Germany are at present the most productive source of uranium being exploited by the Soviets. It is estimated that this source provided about 50 per cent of the estimated total Soviet uranium production in 1954. Uranium mining operations in eastern Germany were begun by the Soviets in October 1946. At first, they were confined to the Erzgebirge, in Saxony, around the towns of Johanngeorgenstadt, Oberschlema, Niederschlema, Schneeberg, Aue, Annaberg, Marienberg, Schwarzenberg, Freiberg, and Dresden. The operations have continually expanded and in 1954 the area around Auerbach, Oelsnitz, Bergen, and Schmiedeberg (East Germany) and Thuringia (near Gera, Ronnebourg, and Sorge Settendorf where large quantities of low-grade ore are mined. Prospecting operations have been conducted in all possible areas. Uranium of all qualities has been mined -- a fairly large amount of high-grade ore and very great amounts of low-grade ore. The greatest portion of uranium shipped from Germany is in the form of so called high-grade ore with an average U-metal content of about 1.50 per cent (obtained by hand and machine sorting).

Based upon the present extent of operation, it is estimated that uranium production in Germany will continue at the present level for at least three or four more years before gradually declining.

(2) Operations -- Soviet uranium mining operations in Germany are under the control of a Soviet-German company called "Wismut S. D. A. G.". Wismut, formed in June 1947, is headed by MVD Major General Alexei Matveyevich Bogatov. Subordinate units of Wismut are called "Objekts" and, as a rule, are organized for a specific purpose: some are mining combines controlling a number of mine shafts within a local area; some are mine development projects which build facilities, sink new shafts, extend drifts, etc.; some are concentrating plants; some are engaged in making machinery and tools.

Wismut has opened and developed approximately 400 shafts in Germany since operations began in 1946. The individual shafts, or mines, are too numerous to list in this text, but the main mining objects are as follows:

"Objekt"	Headquarters
1	Johanngeorgenstadt
2	Oberschlema
6	Auerbach
7	Bärenstein
9	Aue
90	Gera
96	Dresden

Wismut has mined solely for uranium. Until recently, there was no attempt made to utilize the silver, cobalt, bismuth, nickel, and other ores which were mined along with uranium ore; these other ores were all thrown on huge waste piles.

Mining methods which are fairly standard for working hard rock vein-type deposits are used by Wismut. Some of the ore is suitable for direct shipment to the USSR, but a great deal of the materials is of such low grade that this is impracticable. This latter material must be concentrated to a grade of at least 1 per cent or more uranium metal before being shipped. Wismut has, at present, eight concentrating plants which process low-grade ore. These plants are: Object 31, at Lengenfeld; Object 32, at Tannenbergsthal; Factory 95 of Object 96, at Gittersee/Dresden; Factory 96 of Object 96, at Freital/Dresden; Object 98, at Johanngeorgenstadt; Factory 99 of Object 2, at Oberschlema; Object 100, at Aue; and Object 101, at Zwickau/Crossen.

About 150,000 workers are employed by Wismut; at least 90 per cent of them Germans. Because production has increased steadily through the years, it is believed that Wismut is currently producing at its peak. Production will probably continue at the present level for the next three or four years before declining slowly.

c. Czechoslovakian Sources

(1) Ore deposits -- The uranium deposits in Czechoslovakia are important source of Soviet uranium. The present output is about 10 per cent of the total estimated production by the USSR in 1954. Unlike East Germany and the other Satellites, mining and supervision is performed by the Czechs. The Soviets are continuing to make great efforts to increase this output and have initiated extensive prospecting and development programs. Prospecting operations have extended throughout Czechoslovakia.

The Soviets took over the uranium mines in Czechoslovakia before September 1945. At that time, a secret agreement was made between the Soviet Government and the Czech Prime Minister Fierlinger whereby the Soviet Government would supervise the exploitation of the Bohemian uranium mines and take the entire output, returning to Czechoslovakia part or all of the recovered radium. Operations were started in the old uranium mines of Jachymov, located on the Czech side of the Erzgebirge. The exploitation was soon extended to the surrounding area and now includes the towns of Vejprty, Abertamy, Potucky, Seify, Bozi Dar, Dürnberg, Maria Sorg, Werlsgrün, and many more. As a result of very intensive exploration programs, new uranium mining areas at Pribram, Horni-Slavkov, Marianske Lazne, Drmoul, Trutnov, and a number of smaller areas have been opened up in Czechoslovakia.

(2) Operations -- The uranium mining operations in Czechoslovakia are directly under the control of "The Jachymov Mines National Corporation". That organization, at least at the higher levels, is jointly administered. The Soviets, however, have virtually complete control of the corporation as most of the Czech officials were chosen on a basis of their cooperation with the USSR and communist party membership. The individual mining areas are under the control of separate enterprises called "Inspectorates". The following are the known Inspectorates with their area of operation:

Inspectorates I and II are located in the area around Jachymov. These are the second most important producer. The principal mines in Inspectorates I and II are the Bratrstvi, Rovnost 1 and 2, Svornost, Joseph, Elias 1 and 2, Marianska, Eduard, Bohumil, Barbara, Eva, and Klavno.

Inspectorate VI is located at Horni Slavkov. At present, this Inspectorate is the largest producer in Czechoslovakia. The principal mines in this inspectorate are Prokop, Barbora, Svatopluk, Lesnice, Zdar Buh, Mines 9, 10, 11, 12, 14, 15, 16, 18, and 19.

Inspectorate K-2 is located at Pribram. It produced a small amount of ore.

The Inspectorate X at Trutnov is still in production. Probably mostly low-grade material is handled here from sedimentary deposits.

Other inspectorates about which little is known and which are probably small producers are the Inspectorate at Marianske Lazne and the Inspectorate at Zvolen.

The method of mining and handling the ore in Czechoslovakia is nearly the same as in Germany. Much of the higher grade ore is sent to the Vykmanov and Njedek collection and shipping depot where it is crushed, sampled, blended, and packed for shipment to the USSR. The low-grade ore is sent to concentrating plants located at the Bratrstvi and the Elias mines in Jachymov. All these plants utilize a mechanical concentration method only. At the present time, there appears to be no chemical concentration plant in operation by the Jachymov Mines National Corporation. The mechanical processing method used is similar to that followed by Wismut. The grade of the concentrate is between 1 and 2 per cent uranium metal. As development and production increase, other concentrating plants may be established in the Horni Slavkov and Pribram areas.

It is estimated that between 15,000 and 25,000 persons are engaged in uranium mining operations in Czechoslovakia. A significant portion of the laborers are Czech political prisoners.

d. Bulgarian Sources

(1) Ore deposits — The uranium deposits in Bulgaria are of minor importance and, in 1954, produced approximately 5 per cent of the estimated

total uranium obtained by the USSR in that year. The deposits being exploited at this time are composed mostly of secondary uranium minerals which occur mainly as thin coatings along fissures or are disseminated throughout brecciated zones. A certain amount of deep mining may now be taking place from the primary minerals.

The most important uranium deposit in Bulgaria is located in the old lead mining area of Goten Peak, near the monestary of Buhovo, northeast of Sofia. In late 1945, the Soviets continued the former German exploitation of this area. Later, exploitation of other areas, such as those in the vicinity of Strelcha and Ihtiman, was begun. Prospecting operations and mining are also underway at a number of other locations.

(2) Operations — The uranium mining operations in Bulgaria are administered by the Soviet-Bulgarian Mining Company. Most of the ore now being produced is low grade and is concentrated before being shipped to the USSR. There is only one well-known ore concentrating plant in Bulgaria which is located at the site of the Buhovo mine. The ore is chemically concentrated, using an acid lead. Some of the ore is reported to be hand-sorted and does not require further concentration before being sent to the USSR, but it is believed that most of it is quite low grade and is first concentrated by the Buhovo plant. The concentrate produced probably contains over 1 per cent uranium. It is estimated that between 6,000 and 10,000 persons are engaged in uranium mining operations in Bulgaria.

c. Polish Sources

(1) Ore deposits — The uranium deposits in Lower Silesia in Poland are of minor importance as a Soviet source of uranium, and constituted approximately 1 per cent of the total produced by the Soviets in 1954.

Soviet uranium mining operations were initiated in Poland in April 1947, but intensive development did not really begin until early 1948. The initial development was in the Kowary area (the old Schmiedeberg area exploited by the Germans) where uranium was produced before the war, and activities have spread to areas around Jelena Gora (Hirschberg), Miedzianka (Kupferberg), Kamienna Gora (Landeshut), Walbrzch (Waldenberg) Stronie Slaskie (Seitenberg), etc.

Exploration is also underway in other areas, but Kowary still seems to be the main producing area.

The uranium deposits in Poland are small fissure veins consisting, in some cases, of martitic iron ore with associated pitchblende. Other veins contain barite and dolomite with some uranium minerals. The extent of the mineralization appears to be somewhat limited but the thoroughness with which the Soviets exploit the deposits, regardless of cost, may produce a small quantity for several years. The quality of the ore produced is not definitely known but is assumed to be the same as that produced in East Germany.

(2) Operations -- The Soviet uranium mining operations in Poland are similar to those in East Germany. Concentrating plants are believed to be operating at Miedzianka and Ogorzelec (Dittersbach). The type of process used in these plants is not definitely known, although it is reported that the plant near Ogorzelec uses a mechanical separation process.

The uranium mining operations in Poland are administered by the Lower Silesian Mines, Kowary. This is believed to be a cover organization similar to Wismut, in East Germany, on a much smaller scale. It is estimated that from 6,000 to 10,000 workers are engaged in the uranium mining activities in Poland.

f. Romanian Sources

(1) Ore deposits -- The uranium deposits of Romania constitute approximately 2 per cent of the total produced by the Soviets in 1954.

Soviet uranium mining operations were initiated in Romania in late 1952. Mining is presently being carried out in the Baia de Cris/W to Baita region and probably also at Baia Sprie, Baia Mare, Turnu Severin and the Galati areas.

The uranium deposits in Romania are small fissure veins of polymetallic minerals with associated pitchblende. The quality of the ore produced is not known. Probably some of it is hand sorted to a minimum grade of 1 or 2 per cent uranium before being shipped to the USSR.

(2) Operations -- The Soviet uranium mining operations in Romania are probably similar to those in other satellite countries, although no

information is available on the existence of any concentration plants.

The uranium mining operations in Romania are administered by the Sovrumquartz Company. This is believed to be a cover organization similar to Wismut, in East Germany. It is estimated that some 10,000 workers are engaged in the uranium mining activities in Romania.

g. China

(1) Ore deposits — Geologically, Sinkiang Province is similar to the adjacent Fergana uraniferous area of the USSR. Uranium deposits of similar variety and extent may be expected in the sandstones, shales, and the vein deposits of the mountains bordering Takla Makan Basin. Very low-grade ores are found in small amounts in pegmatites near Haicheng, Liaotung Province, and may occur in the tin-tungsten mining region of south China. It is unlikely that any extensive high-grade deposits exist in China outside of Sinkiang.

(2) Operations — The only known uranium mining operations occur in Sinkiang Province. The earliest uranium mining began in 1947 under Soviet direction in the pegmatite ores of the eastern Altai. Intensive prospecting and mine development of the red-bed deposits flanking the Tien Shan Mountains began in 1950 under the direction of the Sino-Soviet joint stock company "Sinkiang Rare Metals Development Company," Urumchi. By 1954 low to moderate grade ore was being produced at an unknown rate near Aqsu, Urumchi, Wusu, Kitai, and Kashgar.

In October 1954 it was announced that the Soviet share of all the Sino-Soviet joint stock companies will be transferred to China 1 January 1955. The value of the share to be compensated by supplying to the USSR goods which are items of usual export from the Chinese Peoples Republic. This action is unlike that in the rest of the satellites, in which all joint stock companies except those mining uranium were returned to the control of the respective countries.

2. Uranium Metal

The first uranium metal was produced in 1946 at Elektrostal, near Moscow, on a laboratory scale. Subsequently a factory was constructed at Elektrostal for uranium metal production on an industrial scale using ores

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and concentrates from the satellites as well as from the USSR. Until ore production increased significantly after the uranium mining expansion which began in 1949, all the uranium consumed in the Soviet atomic energy program came from Elektrostal. Since 1949, however, no expansion of the Elektrostal uranium refinery has been reported, and ~~it is reported~~ uranium ore is shipped to Novosibirsk for refining.

A large processing plant at Leninabad, operated by Combine 6, probably produces high-grade concentrates, and may be equipped to produce a uranium salt from local ores. It is doubtful, however, that uranium metal is produced by Combine 6. Details of the process used at Elektrostal are not definitely known;

hydrofluoric acid, pure calcium, and oxalic acid have been sent to this factory, from which it may be assumed that an oxalic acid concentration or purification process is used followed by conversion to uranium tetrafluoride and reduction to uranium metal by the calcium process. Pure calcium for this reduction was produced at Bitterfeld, in Germany, until 1950, (see paragraph 5) and may now be produced at a similar plant in the USSR. There is no evidence that uranium extraction with organic solvents is employed in the USSR.

3. Thorium, and Rare-earths.

Little is known concerning internal Soviet operations concerned with mining or processing ores of these elements. However, the first active interest in monazite, a primary ore of thorium containing some uranium, was noted in late 1945 when Auer Gesellschaft stocks were removed from Germany to the USSR. An active monazite program was believed to have started in 1946, and subsequently intense monazite mining under unusual security was noted at some known monazite deposits. In North Korea, long known as the location of rich monazite placers, moderate monazite mining began about 1947, intensified in 1949, and continued at some locations through the Korean War to the present time. The monazite is shipped to the USSR, and nothing is known concerning processing of the ore. It is believed, on the basis of North Korean activities, that the USSR has accumulated large stocks of monazite or its products.

4. Beryllium

Beryllium compounds have several important applications in an atomic energy program, including reactors, metallurgical refractories and weapons. There is evidence from Soviet ore processing activities which may be interpreted as indicating atomic energy interest in beryllium; however, particular utilization of this material has not been established. In any event, current Soviet production of beryllium appears to be sufficient to support reasonable requirements for atomic energy purposes. The beryllium industry in the USSR started in 1930, and, as an indication of its development, it is known that considerable Soviet effort in research has been expanded in attempting to eliminate or lessen the health hazards connected with it. A fairly large beryllium plant is located at Kol'chugino, Vladimirskaya Oblast. At mines in the Urals, about 55 miles north of Sverdlovsk, emeralds and aquamarines are found in the beryl ore. There are eight large mines in this region and hundreds of small ones. All of these mines have dumps which probably contain large quantities of low-grade beryl of a non-gem quality. Beryl also occurs in widespread pegmatites in the Altai, Pamirs, and Tien Shan mountains. An important deposit is located in the trans-Baikal area at Sherlovaya Gora where beryl is produced in quantity. Beryllium production of USSR can be expected to exceed 30 tons annually and the reserves can be assumed to be very large.

5. Calcium

Utilizing metallurgical processes developed in 1945-1946 by Germans working in the USSR, the Soviets at least until 1950 used high purity calcium for the preparation of pile grade metallic uranium. Between the spring of 1946 and December 1950 when production was discontinued, large quantities of distilled (99% + pure) and raw (92-96% pure) calcium were procured in East Germany for the Soviet atomic energy program. There is also evidence which indicates that the Soviets may have had a calcium distillation plant operation within the USSR since mid-1948. However, there is no direct evidence of the specific metallurgica process in use in the USSR since the termination of German calcium production. It is noted that the distilled calcium alone from this source would be sufficient to support the Soviet plutonium production program prior to mid-1952.

The quantities of raw and distilled calcium procured from East Germany are shown in Figure 2.

6. Magnesium

There have been a few low-grade reports from Bitterfeld that the USSR plans to change from calcium to magnesium for the reduction of uranium to metal. It seems unlikely that these reports are correct in their indication as the Soviets already have an industry and the industrial "know how" for the use of calcium.

7. Pile Quality Graphite

The Soviets currently have a large synthetic graphite industry. During World War II and for a time afterward the USSR, imported substantial quantities of graphite from the West. Information on Soviet research, moreover, indicates a capability to produce reactor-grade graphite. There is also reason to believe that the highest known grade of Soviet commercial graphite would be satisfactory as a moderator and that substantial quantities of this grade are available.

8. Heavy Water

Heavy water (D_2O, deuterium oxide) is highly efficient moderator for a nuclear reactor. Prior to the war, the USSR conducted research on heavy water, as did every other major power. In 1938, a Commission on Heavy Water was established in the Academy of Sciences (later expanded to the Commission on Isotopes). In 1939, a unit under the Pisarzhevski Institute of Physical Chemistry at Dnepropetrovsk installed research equipment, to produce heavy water by electrolysis on a very small scale, at the Dnepr Dam.

At the Conference on Isotopes in April 1940, at which the program for the Academy of Sciences in the field of atomic energy was determined, it was decided to build at the Chirchik Nitrogen Plant near Tashkent, a pilot plant capable of producing approximately 15 kg of pure D_2O per year, an amount sufficient only for laboratory experimentation. A. I. Brodskii wrote in 1944 that this pilot plant was not yet in operation. In 1941 the Pisarzhovski Institute at Dnepropetrovsk was overrun by the Germans and the scientists, together with some minor equipment, were evacuated. Toward the end of the war, L. M. Yakimenko, a deputy chief engineer of the Chirchik Nitrogen Combine, with the aid of engineers of GSPI-3, designed a variation on the Bamag hydrogen electrolyzer specifically for producing by-product heavy water. Simultaneously, work was done on the physical chemistry of electrolytic hydrogen cells at the Institute of Physical Chemistry imeni L. Ya. Karpov in Moscow.

Following the war the Soviets showed considerable interest in German research in the production of heavy water. The principal German pilot plant was located in the Leuna Works at Merseburg. In October 1945, under the auspices of the MVD, a number of individuals specializing in heavy water were assembled at Leuna under the leadership of Dr. Herold. This group drafted the preliminary plans of an H_2S-H_2O exchange plant capable of producing five tons of heavy water per year. Upon the completion of these plans, the Leuna group was evacuated to

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the USSR on 21 October 1946. Herold and his top men were housed in the small town of Babuschkin near Moscow. These people worked at the Institute of Physical Chemistry imeni L. Ya. Karpov until mid-1948 when they were sent to Rubeshnoye in the Ukraine. It is believed that at this time the group's connection with the Soviet heavy water project was terminated and that it was detailed to do engineering work on the construction of the Lisishansk Nitrogen Plant. Whether or not the Soviet constructed an H_2S-H_2O exchange plant is unknown.

In the meantime, the Soviets adopted the method of obtaining heavy water as a by-product from the synthetic ammonia industry. The electrolytic cells at the Chirchik Nitrogen Combine were refitted and the plant as a whole expanded. Electrolytic hydrogen units were installed at the Kirovakan, Dneprodzershinsk, and Gorlovka Nitrogen plants. Manufacture of electrolyzers for these units commenced in October 1946 at the Urals Chemical Machine Factory near Sverdlovsk. It is thought that the Chirchik Nitrogen Plant started to produce heavy water sometime in 1948, but the other plants were not put into operation until late 1950 or early 1951. It is believed that a capacity of at least 60 tons per year has been achieved.

9. Lithium

The quantities of lithium available to the Soviets are very likely sufficient to supply all of their needs, including that required for atomic energy purposes. The principal plant in the USSR for raw lithium production is located at Novosibirsk in the Central Siberian Area (see frontispiece map).

10. Zirconium

The heavy sands also contain zircon. Therefore, the exploitation of heavy sand deposits may be an indication of Soviet plans for the use of zirconium

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as a structural material for reactors, particularly for power types. The zirconium content of the heavy sand deposits being worked is large, and recovered ZrO_2 as of mid-1952 may be as much as 10,000 tons.

11. Other Materials

It is not possible from estimates of the economic resources of the Soviet Union to define the quantities of various essential materials which are allocated for atomic energy purposes. It is believed, however, that quantities of basic materials such as structural and stainless steel, aluminum, nickel, chemicals and the like required for atomic energy purposes would represent only a small percentage of the total Soviet capacity for producing such materials and would not impose any burden on the basic Soviet economy. For example, it is not considered likely that any unusual difficulty would be encountered in supplying the quantity of acid required to process the uranium being recovered.

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I. Production of Fissionable Materials

1. Soviet plutonium production

The USSR has produced two forms of fissionable material in quantity. One is the isotope of uranium having an atomic weight of 235 [redacted], and the other is the synthetic element plutonium made in nuclear reactors [redacted]. The plutonium program progessed moee rapidly than the uranium-235 program so that plutonium was the first fissionable material produced in the USSR.

Information on the availability of uranium, the timetable of construction, the size of facilities, total reactor power level, and the quantity of heavy water available for reactor use provide the basis for the following estimates of the cumulative Soviet plutonium stockpile:

Date	Plutonium
Mid-1949	10 kilograms
Mid-1950	50 kilograms
Mid-1951	100 kilograms
Mid-1952	300 kilograms
Mid-1953	600 kilograms
Mid-1954	1,200 kilograms
End of 1954	1,500 kilograms

2. Soviet uranium-235 production

The USSR undertook an extensive research program on isotope separation concurrently with research for the reactor program. German scientists assisted in this program and carried out specific projects relating to the gaseous diffusion and electromagnetic processes as well as other methods. The success of the program was demonstrated by the use of U-235 in a weapon tested in October 1951. U-235 was also employed in weapons tested during the 1953 and 1954 test series. Production of uranium-235 was probably first accomplished by the electromagnetic method of isotope separation. Production by the gaseous diffusion method followed later.

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Information on Soviet research on specific isotope separation processes, the timetable of developments indicated by tests and site construction, estimated availability of electric power at appropriate sites, and the estimated production of nickel wire mesh provide the basis for the following estimates of the cumulative Soviet uranium-235 stockpile.

Date	Uranium-235
Mid-1951	30 kilograms
Mid-1952	150 kilograms
Mid-1953	350 kilograms
Mid-1954	900 kilograms
End of 1954	1,500 kilograms

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J. Applications

It is obvious from the series of atomic weapons tests in 1949, 1951, 1953 and 1954, that the major objective of the Soviet atomic energy program has been and continues to be the build-up of a large stockpile of a family of atomic bombs as quickly as possible.

It is considered most unlikely that the Soviets would try to produce radioactive isotopes for "radiological warfare" as this would not be the most effective military use of their uranium resources. However, there is evidence from Soviet scientific literature that radioactive isotopes have been produced for tracer and for medical purpose. While it is possible to make these isotopes with particle accelerators, it is much simpler to make them as by-products of pile operation and it is presumed that these materials are such by-products.

Nuclear-powered submarines and planes would add immeasurably to the USSR military potential, and research along these lines has been noted. No evidence of definite accomplishments in the development of a power reactor have been seen other than the announced 5000 KW industrial power reactor to which more political than technical significance has been attached.

K. Comments on Sources

Much of the information on which this Section is based has been obtained from the following types of sources:

1. Returned German and Japanese POWs;

2. Soviet and Satellite defectors;

3. Letter intercepts from German scientists who went to the USSR on contract;

4. Open literature - scientific publications as well as newspapers and radio broadcasts;

5. Covert operations, principally against Satellite uranium mining enterprises;

6. Trip reports by Embassy personnel and other US travelers.

It should also be noted that the knowledge of how successful the USSR has been in espionage against the West has been an important factor in estimating the status of the Soviet atomic energy program. The Fuchs' disclosures indicated the Soviets were fully aware, in 1943 of the United States-United Kingdom-Canadian operations in atomic energy, and had made plans for penetration. Information from the Canadian investigations, the Fuchs' disclosures, and all the other known espionage cases, has contributed significantly to our estimate of Soviet knowledge in this field.

Information collected by the above mentioned means is subject to error and misinterpretation. Although the information on the uranium situation in the Satellites is based on reasonably detailed and accurate information, the descriptions of the activities of the atomic energy program within the USSR are often the result of rather broad deductions based on a large quantity of available peripheral information.

The Soviet atomic weapons tests, carried out in 1949, 1951, 1953 and 1954, have provided us with very important items of intelligence concerning the Soviet atomic energy program. With these facts on hand much of the peripheral information and deductions drawn there from fall into a clear picture of the course of development being followed in the Soviet Union. The information concerning these tests was obtained by means of scientific detection which operates at long range and against which countermeasures are difficult. The details of these methods come under the provisions of the Atomic Energy Act of 1946. This scientific surveillance is still going on.

Information on Soviet atomic energy activities becomes more difficult to obtain, and may be considered of increasing importance, as one passes from mining activity through metallurgy, production of fissionable materials, research programs, production of weapons, details and types of weapons stockpiled, delivery capabilities, and intentions.