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PROVISIONAL INTELLIGENCE REPORT

SUPPLY OF AND DEMAND FOR SULFUR IN THE USSR

CIA/RR PR-156
15 April 1957

CENTRAL INTELLIGENCE AGENCY

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PROVISIONAL INTELLIGENCE REPORT

SUPPLY OF AND DEMAND FOR SULFUR IN THE USSR

CIA/RR PR-156

(ORR Project 20.868)

NOTICE

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FOREWORD

This report develops an over-all estimate of the total sulfur produced in all forms in the USSR and a sulfur supply and demand balance for the 1950-55 period.

Because more than 90 percent of the sulfur produced annually in the USSR is obtained as a byproduct of the recovery and processing of nonferrous metal ores; the cleaning of coals; and, possibly, the refining of natural petroleum crude oils, very little direct information on production is available. The data developed in this report, therefore, are subject to a rather wide range of error. The estimates of production, consumption, and reserves are presented with the qualification that they are preliminary and are subject to revision as more complete and more reliable data become available.

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CIA/RR PR-156
(ORR Project 20.868)

SUPPLY OF AND DEMAND FOR SULFUR IN THE USSR*

Summary

Sulfur is one of the basic raw materials in an industrial economy. Sulfur and its major derivative, sulfuric acid, are key materials in the chemical industry and are used either directly or indirectly in many other industries. The supply of sulfur in the USSR has been, and will continue to be, adequate for all industrial demands. The major economic significance of sulfur in the Soviet industrial structure lies in the fact that more than 90 percent of the total supply of sulfur must be obtained by costly byproduct recovery processes from nonferrous ores, coals, and smelter gases. The USSR has no large, accessible deposits of high-purity elemental sulfur like those in the US, where more than 80 percent of 1955 production came from easily recoverable deposits of 99 percent pure elemental sulfur.

Production of sulfur in the USSR is estimated to have been 1,767,000 metric tons** in 1955. Of this total, 1,414,000 tons were obtained from pyrites and pyrrhotite in nonferrous sulfide ores, 108,000 tons from pyrites recovered in the cleaning of coals, 105,000 tons from smelter gases, and 140,000 tons from deposits of low-purity elemental sulfur. The total 1955 Soviet production of sulfur was about 12 percent of the estimated 1955 world production of 14,375,000 tons. US production of sulfur in 1955, about 7 million tons, constituted almost 50 percent of world production.

Proved and probable Soviet reserves of the kinds of sulfur raw materials now being exploited in the USSR are estimated to be 1,442 million tons. Almost 96 percent of this total is made up of pyrites in coal beds, and only 2 percent is elemental sulfur. US reserves of elemental sulfur are estimated to be from 50 million to 100 million tons, and US reserves of sulfur contained in pyrites, other mineral sulfides, anhydrite, and gypsum have not been estimated.

* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 November 1956.

** Tonnages throughout this report are given in metric tons.

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The largest sulfur-producing area in the USSR is the copper pyrite belt of the Ural Mountains, which accounted for almost 80 percent of the total Soviet production of sulfur in 1955. The largest potential area of sulfur production is the Donets coal basin. The Donets Basin contains more than 1 billion tons of sulfur reserves in pyrites associated with the coals. Other potential sources of sulfur in the USSR are the vast deposits of crude oil and natural gas in the Baku and Ural-Volga areas.

The Soviet Sixth Five Year Plan (1956-60) calls for increased production of sulfur and sulfuric acid and stresses greater recovery of sulfur from the gases of nonferrous metal ore smelters and from crude oil and natural gas. During the period of the Plan the increase in the production of sulfur probably will keep pace with the planned 65-percent increase in over-all industrial production.

I. Introduction.

Sulfur and its derivatives are essential to the industrial economy of the USSR and to those of all other industrialized countries. Sulfur is necessary for the production of food, fertilizers, clothing, medicines, and nearly every industrial product, including military equipment. 1/* The production of explosives, weapons, tires, fuels, guided missiles, ships, rail and motor transport equipment, and many other end items of military supply depends, in part, on derivatives of sulfur.

In the USSR, copper and iron pyrites always have been the major sources of sulfur. In 1938, pyrites accounted for about 65 percent of the 226,700 tons of sulfur produced. 2/ Mined elemental sulfur and byproduct sulfur recovered from waste smelter gases and the refining of petroleum provide the remainder of the supply of sulfur.** 3/

Production of sulfur increased throughout the 1930's but declined sharply during World War II because of the disruption or capture of 50 percent of the Soviet sulfuric acid industry, the chief consumer of

* For serially numbered source references, see Appendix C.
** Estimates referring to sulfur source materials throughout this report are stated in terms of sulfur content.

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sulfur. 4/ Sulfur or pyrites were not shipped to the USSR from the West during the war. The ensuing shortage of sulfur and sulfur products was partially alleviated by the shipment of large quantities of finished products such as explosives and steel, which require sulfur in their production.

II. Raw Material Resources.

The USSR has an almost inexhaustible supply of sulfur-bearing materials. These include elemental sulfur; pyrites, a natural sulfide of iron or copper; pyrrhotite, an iron sulfide; gypsum, a hydrated calcium sulfate; glauber's salt, a hydrated sodium sulfate; coke, generator, and other gases containing hydrogen sulfide; the sulfur content of petroleum; and combined sulfur in the copper, lead, and zinc sulfide ores. 5/ Not all of these sources have been utilized in the USSR for the recovery of sulfur.

Elemental sulfur deposits vary in size from small to relatively large, low-grade, surface or near-surface deposits located for the most part in the middle Volga area and Soviet Central Asia. No domes of the Texas type have been located in the USSR. Elemental sulfur deposits account for only a small part of the total sulfur materials recovered annually in the USSR. 6/ In the US, mined elemental sulfur accounts for 80 to 85 percent of the production of sulfur materials. 7/ Elemental sulfur deposits in the US are associated with salt domes in Texas and Louisiana, and the mined product has a sulfur content of 99.5 percent. 8/ Pyrites account for only 5 or 6 percent of the sulfur materials recovered annually in the US.

Pyrites are by far the largest and most important source of sulfur in the USSR. Pyrites are obtained from mines operated for the recovery of pyrites alone and from copper, lead, and zinc ore mines from which the pyrites are recovered as a byproduct of the dressing of these nonferrous metal ores. Iron pyrites are recovered at coal mines in the cleaning of the coal. 9/

A large deposit of pyrrhotite located in the Kola Peninsula is being utilized as a source of sulfur for a sulfuric acid plant at Monchegorsk. 10/ Experiments on the utilization of gypsum and glauber's salt as sources of sulfur have been successfully completed in the USSR. It is not likely, however, that commercial production of sulfur from

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gypsum and glauber's salt, which involves a more complicated and costlier operation, will begin in the near future. 11/ Although the methods of recovery of the sulfur content from coke, generator, and other waste gases containing hydrogen sulfide are known in the USSR, there is little evidence that utilization of these sources accounts for much of the total sulfur produced annually. 12/

III. Production.

A. Major Sources.

1. Pyrites.

a. Distribution and Characteristics of Major Deposits.

The principal pyrite deposits are in the Ural Mountains area, the Kola Peninsula, the Transcaucasus, Kazakhstan, Central Asia, East Siberia, and the Soviet Far East. 13/ Most of these deposits are mined primarily for copper, lead, or zinc, and pyrites are the principal byproduct. The only known exception is the Zyuzelskiy pyrite mine in the Polevskoy district of the Ural Mountain area, which is mined for pyrites alone. The nine copper pyrite mining areas in the Urals* which produce copper and zinc as the primary product are the largest producers of sulfur in the USSR. 14/ Other important pyrite sources are the copper pyrite deposits at Alaverdi and Kafan in the Caucasus and at Almalyk in Uzbek SSR and the lead-zinc sulfide deposits at Salair in West Siberia and in the Lake Baikal and Tetyukhe-Pristan regions of East Siberia. 15/ Although much of the coal in the USSR has a relatively high sulfur content in the form of pyrites, the recovery of pyrites from coal has been reported only from the Moscow and Donets Basins. 16/ The principal pyrite deposits and mines in the USSR in 1955 are given in Table 1** and in Figure 1.***

b. Methods and Quantities of Production.

Pyrites, the major source of sulfur in the USSR, are recovered in a byproduct operation, and little direct information on****

* The first nine areas listed in Table 1, p. 5.
** Table 1 follows on p. 5.
*** Following p. 8.
**** Continued on p. 9.

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Table 1

Principal Pyrite Deposits and Mines in the USSR
1955

Type of Mine or Deposit	Location	Coordinates		Name of Mine	Remarks
		North	East		
Copper, pyrites, and zinc	Degtyarka 17/	56°44'	60°05'	Degtyarka	Single pyrite lens located 18 kilometers (km) southeast Revda.
Copper, pyrites	Blyava 18/	51°24'	57°45'	Blyava	Second to Degtyarka in magnitude of reserves.
Copper, pyrites, and zinc	Kirovgrad (Kalata) 19/	57°27'	60°03'	Levikha Karpushikha	Consists of 12 separate lenses. One sulfur pyrite lens, 1 polymetallic lens.
				Kalata Oblavenskiy	Consists of 4 lenses.
				Belorechikha	Located 12 km south of Kirovgrad.
				Nevyyansk Shaitunskiy	
Copper and pyrites	Krasnoural'sk 20/	58°20'	60°03'	Novo-Levinskiy Krasnogvardeyskiy Spasso-Sernia-Chalchedonia Andreyevskiy Kaban Mountain	
				Yasvinskiy Vinnovskiy	Small deposit. One small lens.

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Table 1

Principal Pyrite Deposits and Mines in the USSR
1955
(Continued)

Type of Mine or Deposit	Location	Coordinates		Name of Mine	Remarks
		North	East		
Copper, pyrites, and zinc	Karabash 21/	55°28'	60°15'	Voroshilovskiy	Consists of 2 parallel lenses. Ore body located 1 km north of Voroshilovskiy.
				Dzerzhinskiy	
				Stalinskiy	
				Pervomayskiy	
				Severo-Pervomayskiy	
				Pionerskiy	
				Yugo-Kuznechinskiy	
				Severo-Kuznechinskiy	
Copper, pyrites, and zinc	Nizhniy Tagil (San Donato) 22/	57°54'	60°00'	Third International	Most important mine in the district.
				Dinamitnia	0.5 km northeast of Third International
				Olkhovka	
Pyrites	Polevskoy 23/	56°30'	60°10'	Zyuzelskiy (Zuleski)	Worked solely for sulfur pyrites in 1935.
Pyrites	Baymak 24/	52°36'	58°22'	Bakr-Uzyick (Bakrusak)	
				Sibay (Cebi)	Located 30 km northwest of Baymak.
				Buribay	
				Yuluk	
				Gumerovskiy	New deposit in 1935.
				Turbinskiy	

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Table 1

Principal Pyrite Deposits and Mines in the USSR
1955
(Continued)

Type of Mine or Deposit	Location	Coordinates		Name of Mine	Remarks
		North	East		
Copper and pyrites	Verkhnyaya Pyshma 25/	56°55'	60°37'	Aleksandrovskiy Pokrovskiy Srednic Mariyenskiy Kvanovskiy	
Pyrites and pyrrhotite	Karelo-Finskaya ASSR 26/ Parandovo	64°00'	34°19'	Parandovo	Developed to form basis of acid plants for use with local phosphate rock.
Pyrites and copper	Monchegorsk 27/	67°54'	32°58'	Monchegorsk	Sulfuric acid plant associated with copper refining operations.
Pyrites, lead, copper, and zinc	Transcaucasus Buron 28/	42°47'	43°59'	Buron	Mine located in the Ardon Valley near Sadon.
	Alaverdi 29/	41°06'	44°39'	Alaverdi	Copper pyrites.
	Kafan 30/	39°12'	46°26'	Kafan	Copper pyrites.
	Mizur 31/	42°52'	44°05'	Mizur	Lead-zinc sulfides.

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Table 1

Principal Pyrite Deposits and Mines in the USSR
1955
(Continued)

Type of Mine or Deposit	Location	Coordinates North	Coordinates East	Name of Mine	Remarks
Pyrites and copper	Kazakhstan 32/				
	Kounradskiy	47°00'	74°59'	Kounradskiy	Copper pyrites.
	Dzhezkazgan	47°51'	67°14'	Dzhezkazgan	
	Achisay	43°35'	68°53'	Achisay	Lead-zinc sulfides.
	Leninogorsk	50°22'	83°22'		Lead-zinc sulfides.
	Zyryanovsk	49°43'	84°20		Lead-zinc sulfides.
	Dzhetygara 33/	52°11'	61°12		Pyrites.
Pyrites and copper	Central Asia 34/				
	Almalyk	40°49'	69°38'	Almalyk	Ores processed at nearby metal plants.
	Kansay	40°29'	69°44'	Kansay	Lead-zinc sulfides.
Lead-zinc	West Siberia 35/				
	Salair	54°13'	85°47'	Salair	
Lead-zinc sulfides	East Siberia 36/				
	Lake Baikal area	54°00'	109°00'		Lead-zinc sulfides.
	Far East 37/				
	Tetyukhe-Pristan	44°22'	135°51'		Located near Tetyukhe-Pristan, lead-zinc sulfide.
Sulfur, pyrites	Donets Coal Basin 38/	48°32'	38°35'		Other sources of sulfur are the "pyritic brasses" in the main coal basins. 3 to 4 percent sulfur reported in recoverable pyrites in the Donets Basin. 2 to 6 percent sulfur reported in pyrites in the Moscow Basin.
	Moscow Coal Basin	54°40'	39°32'		

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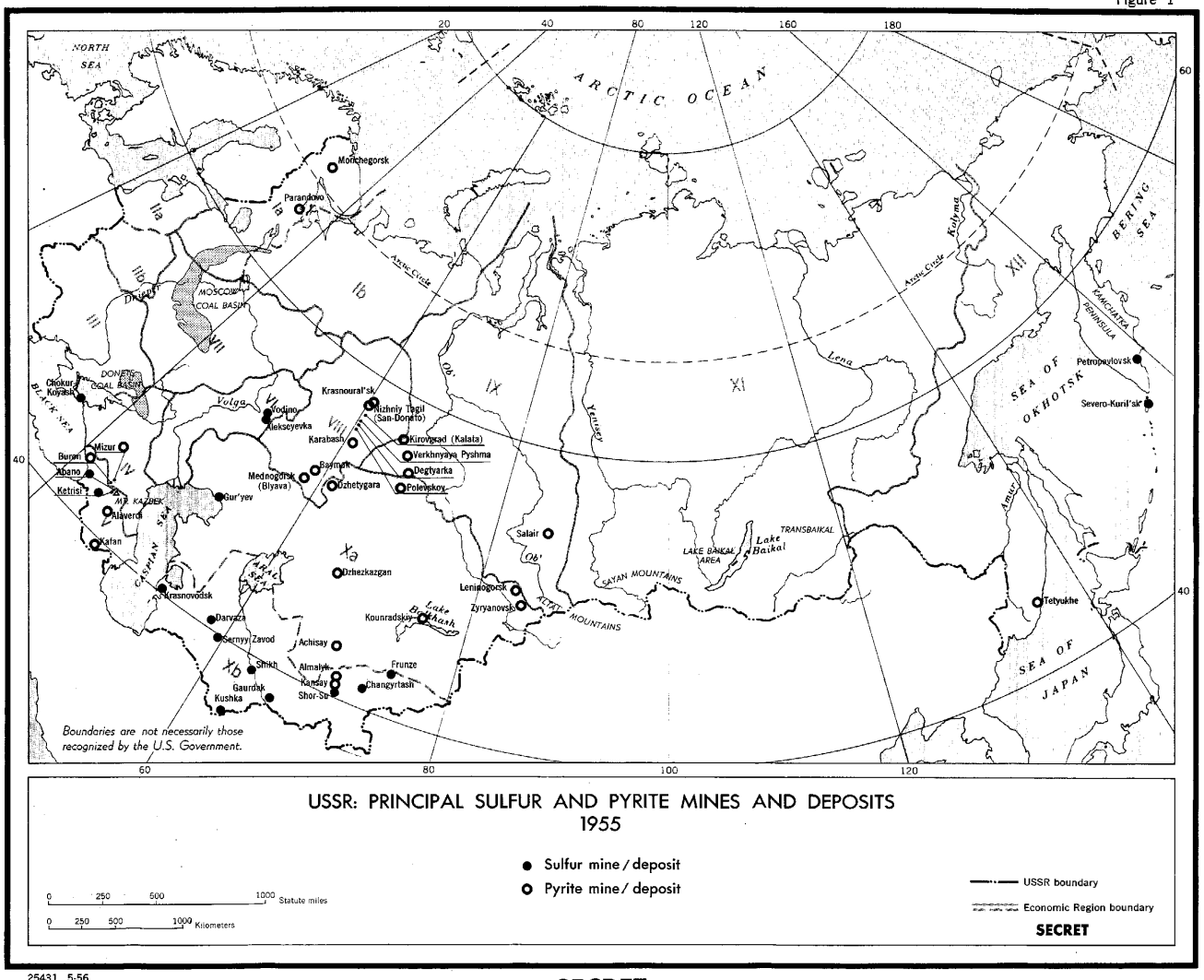
Figure 1



USSR: PRINCIPAL SULFUR AND PYRITE MINES AND DEPOSITS
1955

● Sulfur mine / deposit
○ Pyrite mine / deposit

0 250 500 1000 Statute miles
0 250 500 1000 Kilometers

USSR boundary
Economic Region boundary

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production is available. 39/ In some mines the pyrites are separated from the ore and shipped to chemical plants for sulfur recovery. 40/ In others, some of the pyrites are shipped to chemical plants, and the remainder is included with the ore shipped to the smelters. When the pyrites are shipped to the smelters with the ore, the sulfur content of the pyrites -- and the relatively small quantity of combined sulfur in the sulfide ores -- are recovered from the waste smelter gases in the form of sulfur dioxide. The dioxide is converted to, and reported as, sulfuric acid or as elemental sulfur. 41/ The iron pyrites produced at coal mines represent pyrites recovered in the cleaning of coals and utilized by the sulfur industry or the sulfuric acid industry. 42/ Estimated production of sulfur in the USSR in 1950-55 is shown in Table 2.*

2. Elemental Sulfur.

a. Distribution and Characteristics of Major Deposits.

The elemental sulfur deposits in the USSR are of medium and low grades. The sulfur occurs for the most part as thin seams of impregnations in limestone, sandstone, and gypsum. Although some of the deposits are relatively large, the sulfur content averages only 24 percent. Sulfur of a 99.5-percent purity comes from domes of the Texas type in the US. Such domes are not known to exist in the USSR. 43/

The major deposits of elemental sulfur in the USSR are in the middle Volga area and in Central Asia. 44/ Other smaller operating mines are the Chokor-Koyash in the Ukraine and the Changyrtash mine in Kirgiz SSR. 45/ Deposits of sulfur in East Siberia and the Soviet Far East have been reported, but exploitation probably has not begun. 46/ Principal sulfur deposits and mines in the USSR in 1955 are shown in Table 3** and in Figure 1.***

b. Methods and Quantities of Production.

All elemental sulfur deposits in the USSR are of low grade and contain many impurities, and all mined sulfur ore must be beneficiated****

* Table 2 follows on p. 10.
** Table 3 follows on p. 11.
*** Following p. 12.
**** Continued on p. 13.

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Table 2

Estimated Production of Sulfur in the USSR a/
1950-55

Raw Material Source	1950 Production (Thousand Metric Tons)	1950 Percent of Total	1951 Production (Thousand Metric Tons)	1951 Percent of Total	1952 Production (Thousand Metric Tons)	1952 Percent of Total	1953 Production (Thousand Metric Tons)	1953 Percent of Total	1954 Production (Thousand Metric Tons)	1954 Percent of Total	1955 Production (Thousand Metric Tons)	1955 Percent of Total
Nonferrous ores b/												
Pyrites and pyrrhotite	970	77	1,210	80	1,500	83	1,316	81	1,237	79	1,414	80
Waste smelter gases	105	8	105	7	105	6	105	6	105	7	105	6
Subtotal	1,075	85	1,315	87	1,605	89	1,421	87	1,342	86	1,519	86
Pyrites in coal c/	83	7	89	6	92	5	97	6	101	6	108	6
Mined elemental sulfur	100 d/	8	100 e/	7	100 f/	6	110 g/	7	124	8	140	8
Total	1,258		1,504		1,797		1,628		1,567		1,767	

a. For the methodology used in the derivation of undocumented estimates, see Appendix A.
b. Production estimates are given in terms of recoverable sulfur content of the pyrites in copper, lead, and zinc ores.
c. Production estimates are given in terms of recoverable sulfur content of pyrites recovered at coal cleaning plants and shipped to sulfuric acid plants.
d. 47/
e. 48/
f. 49/
g. 50/

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Table 3

Principal Sulfur Deposits and Mines in the USSR
1955

Location	Coordinates	Remarks
Volga Area 51/		
Vodino	53°22' N - 50°26' E	Two productive horizons in Permian limestone ores range 7 to 20 percent sulfur. Ore averages about 11 percent sulfur.
Alekseyevka	53°15' N - 50°25' E	
South (Ukrainian SSR and Moldavian SSR) 52/		
Chokur-Koyash	45°03' N - 36°12' E	Fifteen percent sulfur ore is mined through adits and treated in an ore-dressing plant at the mine.
Georgian SSR 53/		
Ketrisi	42°36' N - 44°24' E	Deposits located on the north slope of Gora Kazbeck along the Georgian military highway. Ketrisi was worked from 1896 to 1914.
Abano	42°12' N - 43°45' E	
Central Asia 54/		
Gaurdak	37°50' N - 66°04' E	Mineralized area extends to Shirabad: largest single sulfur deposit in the USSR.

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Table 3

Principal Sulfur Deposits and Mines in the USSR
1955
(Continued)

Location	Coordinates	Remarks
Central Asia (Continued)		
Shikh	38°46' N - 63°56' E	Small, high-grade deposit averaging 50 percent sulfur.
Krasnovodsk	40°00' N - 53°00' E	On the east coast of the Caspian Sea.
Darvaza	40°10' N - 58°20' E	In the Kara Kum desert.
Sernyy Zavod	39°59' N - 58°52' E	Deposit located about 140 km north of Ashkhabad in the Kara Kum desert.
Frunze	42°54' N - 74°36' E	Sulfur mined within 25 to 30 km of Frunze. Located in the Sosamir Mountains.
Changyrtash 55/	40°50' N - 72°50' E	A high-grade deposit in the Fergana Basin.
Kushka	35°16' N - 62°24' E	Near the Afghanistan border.
Shor-Su 56/	40°17' N - 70°50' E	Outcrops of bitumen-bearing limestone with high sulfur content; deposit averages 15 to 24 percent sulfur.

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Table 3

Principal Sulfur Deposits and Mines in the USSR
1955
(Continued)

Location	Coordinates	Remarks
Kazakhstan 57/		
Gur'yev	47°07' N - 51°53' E	Sulfur deposit and springs. Up to 1940 had produced 4,000 tons of sulfur.
East Siberia 58/		
(Altay) Sayan Mountains	52°45' N - 96°00' E	Deposits of sulfur known but not explored.
Transbaykal	51°58' N - 116°35' E	Deposits of sulfur known but exploration not completed.
Far East		
Severo-Kuril'sk 59/	50°42' N - 156°13' E	Mine located 1.5 km south of Severo-Kuril'sk.
Kamchatka Peninsula 60/	56°00' N - 160°00' E	Sulfur in volcanic areas.
Petropavlovsk-Kamchatskiy 61/	53°01' N - 158°39' E	Natural sulfur discovered in the vicinity of Avachinskaya.

before marketing. 62/ The mines are either relatively small open pits or shallow underground mines. 63/ Totals of production by mines are not available. Alekseyevka and Vodino in the Volga area and Gaurdak, Darvaza, Sernyy Zavod, and Shor-Su in Soviet Central Asia account for

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the bulk of the annual production of refined sulfur. 64/ These mines have processing plants adjacent to the mines. The annual capacity of the refinery in the Gaurdak mining area, the largest single sulfur-mining area in the USSR, has been estimated at 50,000 tons. 65/

Just before World War II the Sernyy Zavod and Darvaza mines in the Kara Kum desert accounted for about one-third of the total Soviet production of sulfur. After World War II, new deposits were discovered in the Darvaza area, and a large flotation plant was installed there. 66/ Production and processing costs are relatively high because of the lack of basic transportation facilities, and supplies, equipment, and the refined sulfur are moved in and out by air transport. 67/

The mining of elemental sulfur in the USSR is a relatively simple operation and requires a minimum of equipment. 68/ The processing of the mined material is essentially the same in all of the large plants. It consists of primary crushing of the ore, mechanical screening, flotation of the screened product to obtain a concentrate, charging of the concentrate to an autoclave furnace for melting, and pouring the molten sulfur into molds. Some sulfur is shipped to consumers in the molded form, and the remainder is ground to a fine powder before shipment. 69/ The total estimated annual production of elemental sulfur in 1950-55 is shown in Table 2.*

In addition to the production of sulfur estimated in Table 2, possibly 50,000 tons of byproduct sulfur may be recovered annually from the processing of natural crude petroleum in the Ural-Volga area.** Sulfur derived from petroleum has not been included in the production estimate, however, because there is no evidence that the USSR actually practices such commercial recovery.

3. Waste Smelter Gases.

Soviet copper, lead, and zinc sulfide ores -- such as chalcocite, chalcopyrite, galena, and sphalerite -- contain quantities of sulfur. Because sulfur is a harmful impurity in finished metal, this sulfur must be removed in the processing of these ores. The sulfur is in the molecular structure of the ore crystals, and it cannot be recovered by mechanical separation but must be driven off as a gas.

* P. 10, above.
** For the derivation of this estimate, see Appendix A.

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The waste gases from the smelter pass through a precipitation unit where the sulfur content is recovered in the form of a sulfurous anhydride (SO_2), which is reduced to either elemental sulfur or sulfuric acid.

B. Miscellaneous Sources.

In an effort to create a sulfur industry, the USSR listed as early as 1933 all domestic sources of sulfur and possible methods of recovery. 70/ Commercial production from some of these sources, however, has not yet been reported.

In 1953 there were published some details of a Soviet method for the production of elemental sulfur and sulfuric acid from anhydrite and gypsum using anhydrite or gypsum and alumina in the form of kaolin. 71/ Commercial production of sulfur or sulfuric acid by this method has not yet been reported. Several processes for the recovery of sulfur compounds from combustion gases are also under investigation in the USSR. 72/ The large Kara-Bogaz-Gol sulfate combine, which recovers glauber's salt (sodium sulfate), is another excellent source of sulfur. Although much has been reported on the quantity of sulfur available or recovered, the latest reports show that the Central Committee of the Turkmen Communist Party and the Council of Ministers of Turkmen SSR have not yet arrived at the final solution to the problem, and industrial production of sulfur from sulfate raw materials is to be started by 1957. 73/ The recovery of sulfur as sulfuric acid from the waste products of the manufacture of phosphate fertilizer is also being investigated in the USSR. 74/

Although pyrites have been recovered in coal-cleaning operations in the USSR for about 25 years, efforts were still being made in 1953 to perfect a chemical gravity method for recovering ash and sulfur from coking coal. 75/ The chemical gravity method is said to improve the coal product and also to increase recovery of pyrites and sulfur.

C. Total Production of Sulfur.

1. Current.

As shown in Table 2,* about 92 to 94 percent of the total sulfur produced in the USSR is recovered as a byproduct in the dressing and smelting of nonferrous sulfide ores and the cleaning of

* P. 10, above.

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coals. Mined elemental sulfur accounts for the remaining small percentage of the total annual production of sulfur. Although a recent report indicates that greater emphasis is to be placed on increasing the annual production of mined elemental sulfur, 76/ it is probable that pyrites will continue to be the major source of sulfur in the USSR during the Sixth Five Year Plan period.

2. Forecast, 1956-60.

Because of the many industrial uses of sulfur, the planned 65-percent increase in industrial production during the Sixth Five Year Plan 77/ will necessitate a similar increase in the production of sulfur. By 1960 this increase will be more than adequate for planned consumption, even if a 91-percent increase in the production of sulfuric acid takes place as planned. 78/ Estimates of the Soviet production of sulfur in 1956-60 are as follows*:

Year	Quantity (Thousand Metric Tons)
1956	1,990
1957	2,200
1958	2,550
1959	2,690
1960	2,915

3. Potential.

In addition to the estimated production of sulfur in the USSR in 1950-55 as shown in Table 2,** it is possible for the USSR to increase production of sulfur considerably by enlarging the present type of equipment for the recovery of byproduct sulfur at coal-cleaning plants and petroleum refineries.

Annual sulfur recovery from the Donets and Moscow coal basins has been estimated at only 83,000 to 108,000 tons for 1950-55, but the potential from this source is tremendous. The sulfur content of the coals in these 2 basins, in the form of pyrites, is estimated at 1.5 to 6 percent, with an average of 2 percent recoverable. 79/

* For derivation of these estimates, see Appendix A.
** P. 10, above.

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From these fields the total production of coal in 1955 was 168.5 million tons, 80/ from which 3.37 million tons of sulfur could have been recovered. A large part of this potential could have been recovered by better utilization of the present equipment at coal-cleaning plants. A Soviet source reported in 1955 that if electric power stations which burn coal mined in the Moscow region were equipped with installations for sulfur recovery, about 500,000 tons of sulfur dioxide, 200,000 tons of elemental sulfur, could be recovered annually. 81/

In the US, on the other hand, production of sulfur from pyrites recovered at coal-cleaning plants is negligible, principally because of the abundant supply of low-cost elemental sulfur. 82/ Some sulfur has been recovered from Midwestern coalfields, but the cost of a sulfuric acid plant utilizing pyrites in the US is about twice as much as one of the same production capacity using crude elemental sulfur. Consequently, production of sulfur from such material in the US probably will remain small. 83/

The potential tonnage of sulfur recoverable from crude petroleum stocks in the USSR in 1955 has been estimated at 737,000 tons from the Ural-Volga fields. Although high-sulfur crude oils are also produced in the Central Asian and Sakhalin Island fields, the quantities are small and are not considered in this report. 84/ The potential of 737,000 tons is based on an average of 2.2 percent, by weight, of sulfur in the natural crude petroleum of the Ural-Volga fields 85/ and a 1955 production of 33.5 million tons of crude petroleum. 86/ Adding the potential recoverable sulfur from pyrites in coal beds and natural crude petroleum stock, the total additional potential sulfur available in the USSR annually is about 3.9 million tons, which is more than twice as much as the 1955 estimated total production of sulfur.

The desulfurization of natural petroleum crude oils in the US, for example, has been practiced for many years. The recovery of this sulfur content, however, did not start until the post-World War II period and was not really significant until 1950. In 1953 the petroleum refineries in the US recovered 81,298 tons of hydrogen sulfide containing 74,964 tons of sulfur. This tonnage is estimated to have increased markedly in 1955 because of the generation of hydrogen sulfide gas in the new catalytic hydrogenation processes for desulfurization of naphtha stocks installed in 11 US refineries. 87/

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D. Unmined Reserves.

The USSR has an almost unlimited supply of proved and probable unmined reserves of sulfur raw materials. At the current rate of production and consumption, the supply is adequate for many years of operation. Iron pyrites (coal brasses) found in coal beds, as shown below, contain by far the largest share of the total known unmined reserves. 88/ Elemental sulfur is the next largest reserve. 89/ The 9 million tons of sulfur in pyrites must be considered as a minimum, since it represents an estimate from only the Ural Mountain area. In addition, there are reserves of pyrites in the Caucasus, at Noril'sk, and in the Kola Peninsula, as evidenced by sulfuric acid plants in these areas which utilize pyrites as the raw material, 90/ but these reserves are believed to be small.

The reserves of unmined elemental sulfur in the USSR are large, but the material is of relatively low grade. In addition, the deposits vary in sulfur content from 11 to 50 percent, with an average of 24 percent for all deposits. 91/ Estimates of the known exploitable unmined sulfur reserves in the USSR in 1955 are as follows*:

Type of Reserve	Million Metric Tons
Petroleum	17
Pyrites**	9
Pyrites in coal beds	1,382
Elemental sulfur deposits	34
Total	1,442

IV. Trade.

Soviet trade in sulfur in 1950-55 was very small and was made up largely of shipments of pyrites within the Sino-Soviet Bloc. Sulfur from pyrites accounted for 55 percent of total imports and 74 percent of exports for 1950-55. The total tonnage of sulfur involved in trade did not exceed 2.5 percent of the total production in any one year.

* For derivation of these estimates, see Appendix A.

** This figure is a minimum and is not a total estimate of sulfur from this source.

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Trade in sulfuric acid during this period was also very small and followed essentially the same pattern as sulfur.

A. Imports.

Estimated annual imports of sulfur by the USSR in 1950-55 were so small that they may be classed as negligible. The peak year was 1951, when 22,781 tons were known to have been received, a total equal to about 1.5 percent of the total Soviet production of sulfur in that year. In 1952-54, annual imports totaled only a few thousand tons. With the exception of 1,000 tons received from Iran in 1953-54, supplies were received only from Sino-Soviet Bloc countries. Sulfur received from Communist China in 1954 was shipped to the Oji paper mill on Sakhalin Island. 92/ Reports indicate that the USSR requested shipments of 10,000 tons of sulfur from Communist China in 1954, but evidence of shipment of the total quantity is not available. The only other known Bloc supplier of sulfur to the USSR in the period was Bulgaria, which shipped small tonnages of pyrites in 1950-52 and 1954.

Sulfur suppliers outside the Bloc countries were Norway, Yugoslavia, Iran, and Afghanistan. Imports from Norway were received in 1950, and there is no evidence of imports of pyrites by the USSR from Norway since that year. Imports from Yugoslavia and Afghanistan were reported in 1954 and 1955 and from Iran in 1953-55, in conformance with trade agreements between the USSR and these countries. 93/ The known imports of sulfur into the USSR in 1950-55 are shown in Table 4.*

B. Exports.

Exports of sulfur from the USSR in 1951-55 were also small and were confined almost entirely to shipments to other Sino-Soviet Bloc countries. The peak year was 1952, when 37,655 tons of sulfur are known to have been exported. Of this total, 32,378 tons represent the sulfur content of 107,928 tons of pyrites containing 30 percent sulfur shipped to Hungary and Czechoslovakia. These two Satellites have large sulfuric acid industries which use pyrites as raw materials. 94/ It is therefore believed that the sulfuric acid industries of the European Satellites received the bulk of the annual Soviet exports of sulfur. Small shipments of elemental sulfur to Rumania were reported in 1952 and 1954-55. This sulfur probably was utilized in the manufacture of rubber and insecticides.

* Table 4 follows on p. 20.

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Table 4

Known Imports of Sulfur into the USSR a/
1950-55

Metric Tons

Exporting Country	1950	1951	1952	1953	1954	1955
East Germany		16,230 b/	3,000 c/	1,544 d/		
Bulgaria	2,740 e/	6,505 f/	4,250 g/		238 h/	
Poland	481	46				
Communist China					3,046	
Yugoslavia						9,000 i/
Afghanistan					200 j/	
Norway	9,833 k/					
Iran				1,000 l/	1,000 m/	1,000 n/
Total	13,054	22,781	7,250	2,544	4,484	10,000

a. Unless otherwise specified, figures represent elemental sulfur.
b. 95/
c. 96/
d. 97/
e. Represents a total of 9,134 tons of pyrites, estimated to contain 30 percent sulfur.
f. Represents a total of 21,685 tons of pyrites, estimated to contain 30 percent sulfur.
g. Represents a total of 14,166 tons of pyrites, estimated to contain 30 percent sulfur.
h. Represents a total of 792 tons of pyrites, estimated to contain 30 percent sulfur.
i. Represents 30,000 tons of pyrites, estimated to contain 30 percent sulfur. 98/
j. 99/
k. Represents 32,776 tons of pyrites, estimated to contain 30 percent sulfur. 100/
l. 101/
m. 102/
n. 103/

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The export by rail of 5,000 tons of sulfur to Finland in 1955 represents the culmination of trade discussions that began in 1953. 104/ The sulfur is reported to smell of petroleum, and it may have been recovered in the processing of crude oil from the Ural-Volga fields. 105/

The known exports of sulfur from the USSR in 1951-55 are shown in Table 5.*

V. Domestic Demand.

Sulfur is one of the most important basic raw materials used in the chemical industry of the USSR. A Soviet author states the following concerning the uses of sulfur 106/:

> Sulfur bearing ores are valuable raw materials for producing elemental sulfur, which is partially used for the production of relatively concentrated sulfur gases (used for example in the cellulose industry) and sulfuric acid. Sulfur is also used as the starting material for the production of carbon disulfide, sulfur chloride, the vulcanization of rubber, the production of several types of synthetic rubber, for the production of matches, luminous compounds, and other materials. Sulfur is also used as an insectofungicide, especially for the protection of grapes and cotton.

The estimated consumption of sulfur in the USSR in 1950-55 by type of product is shown in Table 6** and Figure 2.***

Figure 2 shows graphically that consumption of sulfur in the USSR increased steadily from 1950 through 1955. Sulfuric acid accounted for about 74 percent of the total amount of sulfur consumed annually. The next largest single consumer is the sulfite pulp industry, which accounts for about 10 percent of the annual consumption. Estimated consumption of sulfuric acid in the USSR in 1950-55 is shown in Table 7**** and in Figure 3./

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* Table 5 follows on p. 22.
** Table 6 follows on p. 23.
*** Following p. 24.
**** Table 7 follows on p. 23.
/ Following p. 24. (Text continued on p. 24.)

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Table 5

Known Exports of Sulfur From the USSR a/
1951-55

Metric Tons

Importing Country	1951	1952	1953	1954	1955
Czechoslovakia	4,600 b/	21,086 c/	5,000 d/	6,847 e/	
Rumania		1,552		1,400 f/	6,930 g/
Hungary	350 h/	14,292 i/	11,768 j/	15,011 k/	5,880 l/
North Korea		725		500 m/	
Finland				60 n/	5,000 o/
Austria					5,000 p/
Bulgaria					65
Total	4,950	37,655	16,768	23,818	22,875

a. Unless otherwise specified, figures represent elemental sulfur.
b. Represents 12,000 tons of pyrites, estimated to contain 30 percent sulfur and 1,000 tons of elemental sulfur. 107/
c. Represents a total of 60,287 tons of pyrites, estimated to contain 30 percent sulfur and 3,000 tons of elemental sulfur. 108/
d. 109/
e. Represents a total of 22,823 tons of pyrites, estimated to contain 30 percent sulfur. 110/
f. 111/
g. 112/
h. Represents 1,165 tons of pyrites, estimated to contain 30 percent sulfur. 113/
i. Represents 47,641 tons of pyrites, estimated to contain 30 percent sulfur. 114/
j. Represents 39,226 tons of pyrites, estimated to contain 30 percent sulfur. 115/
k. Represents a total of 50,037 tons of pyrites, estimated to contain 30 percent sulfur. 116/
l. Represents a total of 19,602 tons of pyrites, estimated to contain 30 percent sulfur. 117/
m. 118/
n. 119/
o. 120/
p. 121/

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Table 6

Estimated Consumption of Sulfur Products in the USSR a/
1950-55

Thousand Metric Tons

Product	1950	1951	1952	1953	1954	1955
Sulfuric acid	728	814	892	981	1,124	1,316
Sulfite pulp	107	119	130	143	157	163
Carbon disulfide	16	19	25	30	38	47
Rubber (vulcanization)	7	8	9	10	10	10
Other b/	119	135	150	165	188	220
Total	977	1,095	1,206	1,329	1,517	1,756

a. For derivation of these estimates, see Appendix A.
b. This category includes consumption for dyes, matches, explosives, insectofungicides, paints, and other minor products.

Table 7

Estimated Consumption of Sulfuric Acid a/ in the USSR b/
1950-55

Thousand Metric Tons

Consuming Commodity	1950	1951	1952	1953	1954	1955
Superphosphate	540	580	627	680	788	954
Petroleum	420	470	526	590	660	785
Coke chemicals	313	357	407	444	480	518
Steel	70	80	88	97	105	115
Rayon viscose	50	62	81	98	121	151
Other c/	647	731	771	841	996	1,167
Total	2,040	2,280	2,500	2,750	3,150	3,690

a. Calculated on the basis of 100 percent acid.
b. For derivation of these estimates, see Appendix A.
c. This category includes consumption for dyes and intermediates, synthetic ammonium sulfate, hydrochloric acid, paints and pigments, explosives, nonferrous metallurgy, and miscellaneous chemical and industrial uses. The amounts indicated in this category were obtained by difference between the total amount of sulfuric acid available and the amount consumed by known consumers.

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VI. Supply and Demand.

Soviet trade in sulfur has been so small that the supply and demand position is determined largely by annual production and consumption. The estimated supply and demand balance of sulfur in the USSR in 1950-55 is shown in Table 8.* As indicated in Table 8, the supply of sulfur in 1950-55 was more than adequate for domestic consumption and for exports.

Supply is estimated to have increased steadily from 1950 through 1952, to have declined in 1953 and 1954, and then to have increased in 1955. The reduction in 1953 and 1954 has been attributed largely to the failure of the Ural Mountain copper-pyrite mines to meet planned production goals. On the other hand, demand for sulfur is presumed to have increased steadily throughout the 1950-55 period. Because sulfur is an essential ingredient in so many industrial processes, it probably will continue to rise as long as industrial production increases. The reserves of sulfur raw materials in the USSR are almost unlimited, and the supply of sulfur in the foreseeable future probably will not become a problem.

As indicated in Table 8, the USSR is estimated to have had a surplus of sulfur in 1950-55 amounting to about 1.6 million tons, a quantity large enough for about 1 year's requirements. The existence of such a surplus is in agreement with all available evidence that the supply of sulfur in the USSR generally satisfies annual demands. An annual breakdown of this excess supply shows that stocks were built up in increasing quantities in the first half of the period and declined in the latter half to an approximate supply and demand balance in both 1954 and 1955.

VII. Inputs.

Information on the fuel, power, manpower, capital, and energy requirements for the Soviet sulfur industry is not available, because 92 to 94 percent of the total sulfur produced (see Table 2**) is recovered as a byproduct operation in the processing of copper, lead, and zinc ores and in the cleaning of coals. A breakdown of the percentage of the various input items utilized in these byproduct operations is not available. Elemental sulfur recovered in mining operations

* Table 8 follows on p. 25.
** P. 10, above.

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FIGURE 2

USSR

ESTIMATED CONSUMPTION OF SULFUR, 1950-55 BY TYPE OF PRODUCT

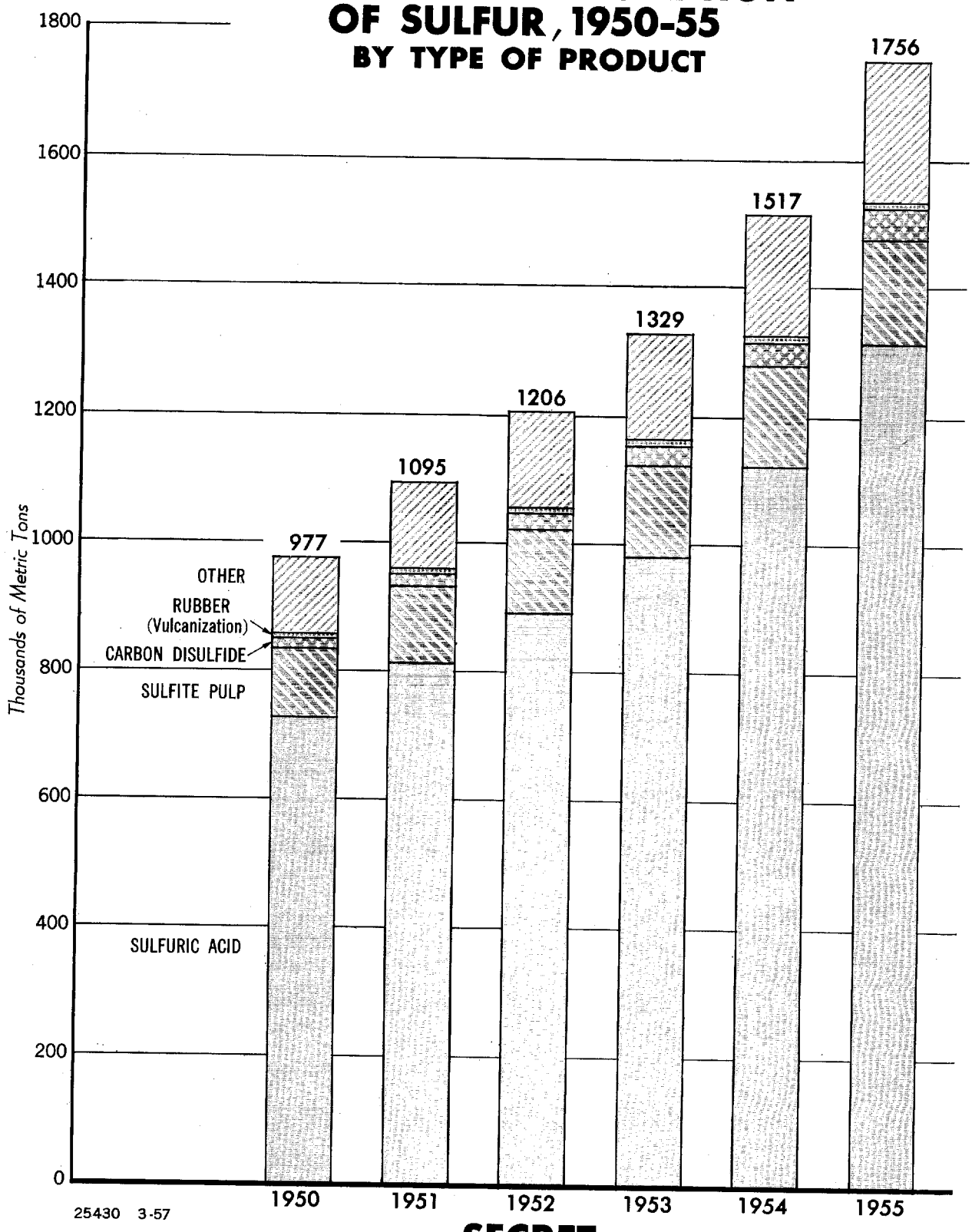

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FIGURE 3

USSR

ESTIMATED CONSUMPTION OF SULFURIC ACID, 1950-55 BY TYPE OF PRODUCT

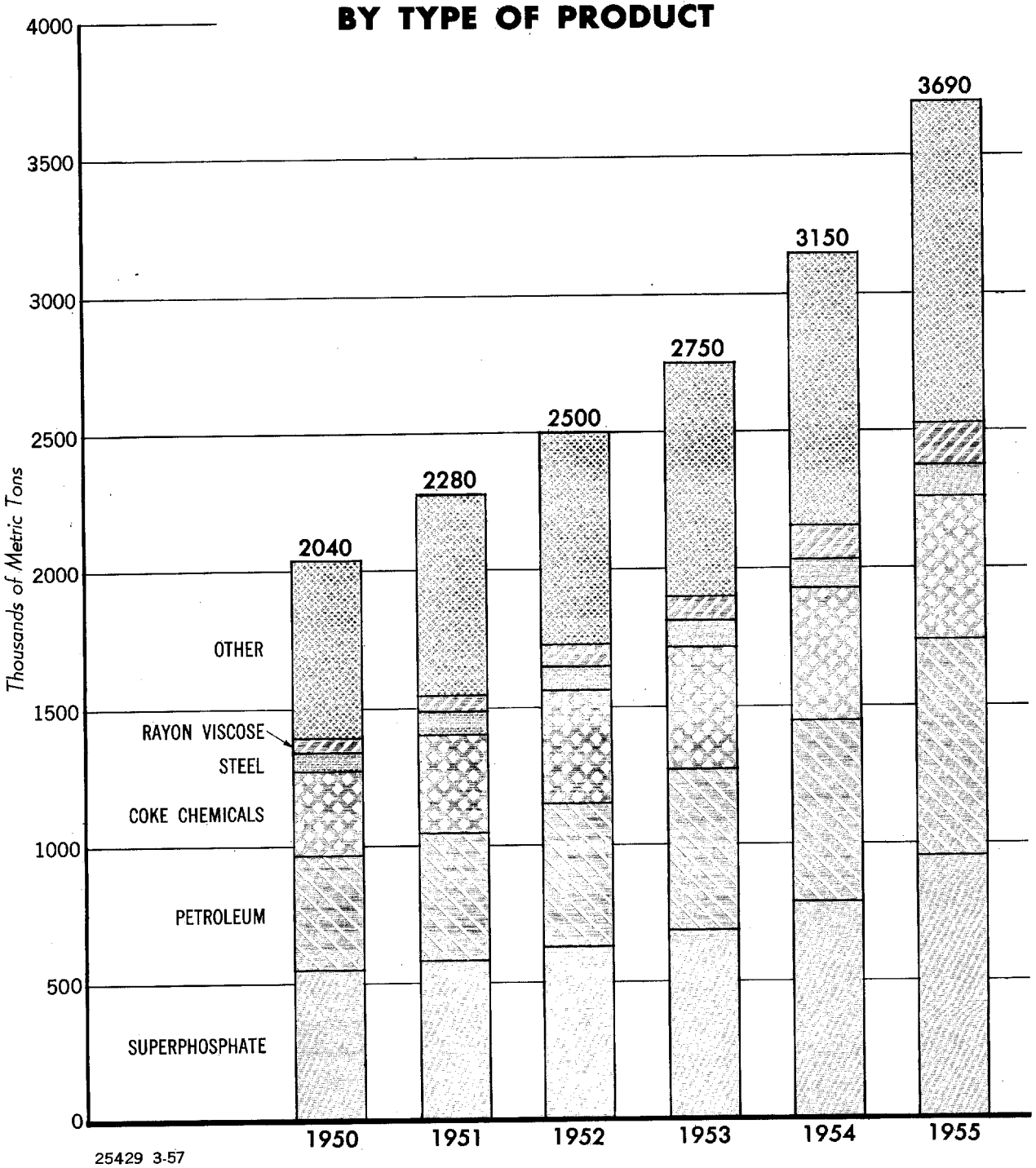

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Table 8

Estimated Supply and Demand Balance of Sulfur in the USSR
1950-55

Thousand Metric Tons

	Supply			Demand		
Year	Production a/	Imports b/	Total Supply	Exports c/	Consumption d/	Total Demand
1950	1,258	13	1,271		977	977
1951	1,504	23	1,527	5	1,095	1,100
1952	1,797	7	1,804	38	1,206	1,244
1953	1,628	3	1,631	17	1,329	1,346
1954	1,567	4	1,571	24	1,517	1,541
1955	1,767	10	1,777	23	1,756	1,779

a. See Table 2, p. 10, above.
b. See Table 4, p. 20, above.
c. See Table 5, p. 22, above.
d. See Table 6, p. 23, above.

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accounts for only 6 to 8 percent of the total annual production of sulfur. Input requirements for this part of the industry are, therefore, of little significance.

VIII. Prices.

The only available internal prices for Soviet sulfur are the 1950 prices reported by the Ministries of the Chemical and the Metallurgical industries. 122/ Those reported by the Ministry of the Chemical Industry are the f.o.b. mine prices of mined elemental sulfur. The metallurgical industry prices are for elemental sulfur produced as a byproduct of the smelting of nonferrous ores. The mined elemental sulfur is reported as ground sulfur and lump sulfur, but only lump sulfur is reported by the metallurgical industry. The internal prices for elemental sulfur in the USSR in 1950 are shown in Table 9.*

There has been no explanation reported for the great difference in price between the mined sulfur and the byproduct sulfur produced at smelters. A possible explanation of the relatively high price of mined sulfur may be that the large native sulfur producing deposits in the Volga region are low in grade, averaging only 11 percent sulfur, 123/ and the other major sulfur mining area is in the remote Kara Kum desert region. In some parts of the latter area, supplies are brought in, and the finished product is shipped out by air transport. 124/ On the other hand, if the USSR follows US practice, prices of byproduct materials are arbitrary prices set by the producer of the major commodity because input costs of the byproducts are not available. Profits obtained from the byproducts are entered as a credit against the cost of the major product. This practice could account for the relatively low price reported if a similar practice is followed in the Soviet sulfur industry.

The 1950 US average price for elemental lump or ground sulfur f.o.b. mine was $20.00 per long ton or $19.40 per metric ton. 125/ On the basis of these data, the ruble-dollar ratio between the US and Soviet sulfur prices is calculated to have been 66 to 1. It should be noted, however, that the occurrence of the tremendous quantities of high-grade and cheaply mineable elemental sulfur in the US is unique. With the exception of recent discoveries of this same type of sulfur in Mexico, virtually all other industrialized countries in the world utilize pyrites as the major sulfur raw material. Thus costs of recovering sulfur in other countries are relatively high when compared with those

* Table 9 follows on p. 27.

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Table 9

Internal Prices for Elemental Sulfur in the USSR
1950

Rubles per Metric Ton

Ministry	Type of Sulfur	Grade	GOST a/	Percent of Sulfur	Price
Ministry of the Chemical Industry 126/	Ground				
		I	127-41	99.5	1,275
		II	127-41	98.0	1,240
		III	127-41	95.0	1,200
	Lump				
		I	127-41	99.5	1,125
		II	127-41	98.0	1,095
		III	127-41	95.0	1,035
Ministry of the Metallurgical Industry 127/	Lump				
		I	1223-41	99.6	600
		II	1223-41	98.6	500
		III	1223-41	96.5	400

a. GOST is the Russian abbreviation for Gosudarstvennyy Obshchesoyuznyy Standart (State All-Union Standard).

in the US. For example, the sales price per metric ton of sulfur in 1955 in East Germany was 224.9 East German marks (DME) (US $101.20) 128/; the import price of sulfur per ton in Poland in 1954 was US $76.00 129/; and a similar price for imports in Czechoslovakia in 1952 was US $114.98. 130/

Most of the sulfur produced in the USSR is from pyrites which are shipped to chemical plants to make sulfuric acid. A smaller tonnage is combined in the copper matte and is taken off in the converters in the form of gas. Some of this gas is converted to sulfuric acid and the remainder to elemental sulfur. Thus the selling price of the pyrites by the metal mining company, or the percentage of the total cost of the manufacturing of sulfuric acid made up by the cost of

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pyrites, would be of the most value. The only available estimates of cost (in rubles) are those which show (1) the cost of the pyrites and (2) the percentage relationship of this cost to the total cost of sulfuric acid production in 1950 by the contact process. 131/ In 1950 the cost of pyrites required to make 1 ton of sulfuric acid by the contact process was 140 rubles, which represented 60.4 percent of the total cost of the production of 1 ton of sulfuric acid. 132/ Inasmuch as 1.2 tons of pyrites containing 30 percent sulfur are required to produce 1 ton of sulfuric acid, 133/ the cost of the pyrites per ton to the sulfuric acid plant was 116.6 rubles. A comparable US price for pyrites in 1950 was $6.83 per ton. 134/ These data yield a ruble-dollar ratio for pyrites of 17 to 1.

The Third Five Year Plan (1938-42) provided that 50 percent of the sulfuric acid would be produced by the contact process and 50 percent by the chamber and tower process. 135/ Plant studies show that this ratio still held in 1953. 136/ An estimate of the costs of pyrites used in the chamber and tower process for producing sulfuric acid in the USSR is not available. On the basis of US experience, it is concluded that if pyrites were utilized as raw material, the cost of production of sulfuric acid by the contact method and by the chamber and tower process would be about equal. 137/ Assuming that costs are comparable in the USSR, the total annual cost of pyrites used in the sulfuric acid plants in the USSR in 1950-55 is estimated as follows:

Year	Production of Sulfuric Acid 138/ (Thousand Metric Tons)	Cost of Pyrites at 140 Rubles per Ton of Acid Delivered to Sulfuric Acid Plants (Million Rubles)
1950	2,040	285.6
1951	2,280	319.2
1952	2,500	350.0
1953	2,750	385.0
1954	3,150	441.0
1955	3,690	516.6

These costs cannot be correlated with US practices, because the raw material for producing sulfuric acid in the US is almost entirely elemental sulfur and the manufacturing processes are entirely different.

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IX. Capabilities, Vulnerabilities, and Intentions.

In 1955 the USSR had an estimated supply of elemental sulfur or sulfur equivalent of 1,767,000 tons. This amount is considered adequate to meet all the domestic and trade requirements in that year. Soviet reserves of sulfur-bearing materials are so large that exhaustion is virtually impossible. The Soviet sulfur industry has no significant vulnerablilties, and it is not a reliable indicator of national intentions.

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APPENDIX A

METHODOLOGY

1. Estimates of Sulfur Production.

The recovery of the pyrites associated with the sulfide ores of copper, lead, and zinc has never been reported separately by the USSR. At some mines and smelters, pyrites are separated in the concentrating process and shipped as a byproduct concentrate to chemical plants for the production of sulfuric acid. In other mines, however, a clean separation of pyrites is not made. Pyrites are contained in the concentrates, the sulfur from which -- together with the combined sulfur in the sulfide ores -- is recovered as sulfurous anhydride (SO_2) from the waste gases. 139/ This sulfurous product is reduced to either elemental sulfur or sulfuric acid. 140/ In view of the lack of information on the separation and disposition of the sulfur content of the pyrites and the sulfide ores, the only method considered feasible to obtain a measure of the sulfur available in the iron and copper pyrites and the combined sulfur in sulfide ores of copper, lead, and zinc is to estimate the sulfur content of these ores.

a. Byproduct Sulfur from Pyrites Contained in Sulfide Ores.

(1) Ural Mountains.

Although the sulfide ores of the Ural Mountains are mined principally for their copper content, they also contain large quantities of sulfur and small amounts of lead and zinc. When the ores are prepared for smelting, they are concentrated in the ratio of about 10 to 1, 141/ so that of each 100 tons of ore mined, 10 tons actually enter a smelter; the remainder can be considered to be tailings. As indicated, however, these tailings contain a large quantity of sulfur in the form of pyrites. Assuming that 60 percent of the tailings are pyrites and using 30 percent as the average sulfur content, the quantity of sulfur available from pyrites can be estimated.

There are no primary data on production of copper ore in the Urals. The first step in estimating the sulfur content of the pyrites of the copper ore, therefore, is to calculate the quantity of ore mined in order to yield the amount of copper estimated to have been

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produced. The estimated production of copper in the USSR in 1950-55 is shown in Table 10.

Table 10

Estimated Production of Copper in the USSR
1950-55

Thousand Metric Tons

Year	Total USSR a/	Kazakhstan a/	Kola Peninsula b/	Other (Excluding Urals) c/	Urals d/
1950	246.6	92.7	6.0	57.4	90.5
1951	281.1	98.3	7.0	62.5	113.3
1952	323.3	109.4	8.0	65.0	140.9
1953	320.8	120.6	8.0	69.0	123.2
1954	336.8	143.3	8.0	70.0	115.5
1955	377.3	166.0	8.0	71.0	132.3

a. The production of copper in the USSR in 1955 is derived from the production in Kazakhstan, which in turn is based on statements in Soviet publications linking current production to production in 1913, which is known. In 1913, production of copper in Kazakhstan was 5,070 tons, 142/ and in 1940, production was 7 times that of 1913. 143/ Production for 1950 was planned at 2.6 times that of 1940, 144/ the plan was fulfilled 100.5 percent, 145/ and the 1955 production was 79 percent greater than that in 1950. 146/ In 1955, Kazakhstan produced 44 percent of the total production of copper in the USSR. 147/ Except for the 1952 and 1954 figures for Kazakhstan, which are interpolations, figures for production in intervening years are based on annually announced percentage increases.

b. 148/

c. Includes copper estimated to have been produced in the Transcaucasus as a byproduct in the nickel operations at Noril'sk and from scrap at Moscow.

d. Obtained by difference between the total for the USSR and the estimated production in Kazakhstan, the Kola Peninsula, the Transcaucasus, Noril'sk, and Moscow.

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The second step is to calculate the quantity of copper ore mined. The estimated production of copper ore in the Ural Mountains in the USSR in 1950-55 is shown in Table 11.

Table 11

Estimated Production of Copper Ore in the Ural Mountains in the USSR 1950-55

Thousand Metric Tons

Year	Copper Metal a/	Smelter Losses b/	Mill Losses b/	Total Amount of Copper Metal in Ore	Estimated Production of Copper Ore c/
1950	90.5	10.0	16.3	116.8	5,840
1951	113.5	12.5	20.4	146.2	7,310
1952	140.9	15.6	25.4	181.9	9,095
1953	123.2	13.6	22.2	159.0	7,950
1954	115.5	12.8	20.8	149.1	7,455
1955	132.3	14.7	23.9	170.9	8,545

a. See Table 10, p. 32, above.
b. 149/
c. 150/ The copper content of Ural ore averages about 2 percent.

The third step is to estimate the quantities of pyrites recovered in the Urals and the sulfur content of these pyrites. The estimated production of pyrites and their sulfur content in the Ural Mountains in the USSR in 1950-55 is shown in Table 12.*

(2) Transcaucasus and Kola Peninsula.

Estimates of production of the pyrites recovered at Alaverdi in the Transcaucasus and at Kirovsk on the Kola Peninsula are based on the reports of sulfuric acid plants at these locations. The plant at Alaverdi uses pyrites, and that at Kirovsk uses pyrrhotite, both of which are also reported to contain 30 percent sulfur. Thus 1.2 tons

* Table 12 follows on p. 34.

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of these products are required to make 1 ton of sulfuric acid. 151/ The estimated production of pyrites and sulfur recovered at Alaverdi in the USSR in 1950-55 are shown in Table 13.*

Table 12

Estimated Production of Pyrites in the Ural Mountains in the USSR 1950-55

Thousand Metric Tons

Year	Copper Ore a/	Copper Concentrate (10 Percent of Ore)	Pyrites Content of Tailings (60 Percent of Remainder)	Sulfur Content of Pyrites (30 Percent)
1950	5,840	584	3,153	945.9
1951	7,310	731	3,947	1,184.1
1952	9,095	909	4,911	1,473.3
1953	7,950	795	4,293	1,287.9
1954	7,455	745	4,026	1,207.8
1955	8,545	854	4,614	1,384.2

a. See Table 11, p. 33, above.

The annual capacity of the sulfuric acid plant at Kirovsk is estimated to have been constant at 40,000 tons in 1950-55. 152/ The annual production and the sulfur required were calculated by the same method used for the Alaverdi plant.

The total sulfur recovered from pyrites and pyrrhotite in the USSR was obtained by adding to the production from the Urals the sulfur equivalent of the sulfuric acid produced at the Kirovsk and Alaverdi plants. The total amount of sulfur recovered from pyrites and pyrrhotite in the USSR in 1950-55 is shown in Table 14.**

* Table 13 follows on p. 35.
** Table 14 follows on p. 35.

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Table 13

Estimated Production of Pyrites at Alaverdi in the USSR
1950-55

Thousand Metric Tons

Year	Production		Sulfur Content of Pyrites
	Sulfuric Acid [a]	Pyrites	
1950	26.0	31.2	9.4
1951	30.6	36.7	11.0
1952	34.0	40.8	12.2
1953	38.0	45.6	13.7
1954	41.8	50.2	15.0
1955	42.0	50.4	15.1

a. 153/

Table 14

Total Amount of Sulfur Recovered from Pyrites and Pyrrhotite in the USSR
1950-55

Thousand Metric Tons

Year	Pyrites			Pyrrhotite from the Kola Peninsula [c]	Total Sulfur from Pyrites and Pyrrhotite
	Urals [a]	Transcaucasus [b]	Total		
1950	945.9	9.3	955.2	14.4	969.6
1951	1,184.1	11.0	1,195.1	14.4	1,209.5
1952	1,473.3	12.2	1,485.5	14.4	1,499.9
1953	1,287.9	13.6	1,301.5	14.4	1,315.9
1954	1,207.8	15.0	1,222.8	14.4	1,237.2
1955	1,384.2	15.1	1,399.3	14.4	1,413.7

a. See Table 12, p. 34, above.
b. See Table 13, above.
c. 154/

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b. Byproduct Sulfur Obtained from Waste Smelter Gases.

Production estimates of the sulfur recovered from waste smelter gases are derived from reports on the capacities of sulfuric acid plants situated at the copper, lead, and zinc smelters. These plants utilize the sulfur recovered from the smelter gases, making 1 ton of sulfuric acid from 0.36 ton of sulfur. The amount of sulfur produced from waste smelter gases used in the manufacture of sulfuric acid is shown in Table 15.* Because there is no indication of any change in the capacities of the sulfuric acid plants during the 1950-55 period, the 1953 production has been taken as the average annual production of sulfur from this source for the entire period.

c. Byproduct Sulfur from Iron Pyrites in Coals.

Estimates of production of iron pyrites recovered in the cleaning of coals and recovering the sulfur content were obtained by the following method. The only available figures on pyrites recovered from coal in the USSR are for the coal from the Moscow and Donets Basin. The Moscow Basin data are for 1933-35 and 1940, and the Donets Basin data are for 1932 and 1940. 155/ Factors obtained by relating total production of coal in the Moscow and Donets Basins to the quantity of pyrites recovered at these times were applied to current estimates of production of coal. These factors, 0.772 for the Moscow Basin and 0.049 for the Donets Basin provided the estimate of the current recovery of pyrites from coal in these basins. The amount of pyrites from coal in the Moscow Basin and the Donets Basin in the USSR in 1932-40 is shown in Table 16.**

These factors derived in Table 16 applied to the 1950-55 estimated coal production from the Moscow and Donets Basins provide an estimate of the pyrites recovered in 1950-55. The estimated amount of pyrites recovered from coal in the Moscow Basin and the Donets Basin in the USSR in 1950-55 is shown in Table 17.***

The estimated pyrites recovered from the 2 fields were then totaled, and a sulfur content of 30 percent was again utilized to obtain the sulfur equivalent obtained from the coal pyrites. The

* Table 15 follows on p. 37.
** Table 16 follows on p. 38.
*** Table 17 follows on p. 39.

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estimated amount of sulfur recovered from coal in the Moscow Basin and the Donets Basin in the USSR in 1950-55 is shown in Table 18.*

Table 15

Amount of Sulfur Produced from Waste Smelter Gases Used in the Manufacture of Sulfuric Acid in the USSR 1953

Thousand Metric Tons

City	Sulfuric Acid	Sulfur Content
Noril'sk	11.7	4.2
Dzaudzhikau a/	25.0	9.0
Chelyabinsk b/	40.0	14.4
Kirovgrad c/	60.0	21.6
Blyava d/	20.0	7.2
Revda e/	45.0	16.2
Leninogorsk f/	25.0	9.0
Krasnoural'sk g/	40.0	14.4
Ust'-Kamenogorsk h/	25.0	9.0
Total	291.7	105.0

a. 156/
b. 157/
c. 158/
d. 159/
e. 160/
f. 161/
g. 162/
h. 163/

* Table 18 follows on p. 39.

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Table 16

Estimated Amount of Pyrites Recovered from Coal in the Moscow Basin and the Donets Basin in the USSR
1932-40

Year	Amount (Thousand Metric Tons) Production of Coal in the Moscow Basin a/	Pyrites Recovered b/	Percent of Total	Amount (Thousand Metric Tons) Production of Coal in the Donets Basin	Pyrites Recovered	Percent of Total
1932				45,044	15	0.033
1933	3,833	28	0.73	51,060		
1934	4,619	38	0.82	64,496		
1935	5,700	40	0.70	69,500		
1936	7,100			78,600		
1937	7,506			77,542		
1938	7,416			80,733		
1939	8,100			85,300		
1940	9,950	80	0.80	94,400	54	0.057
		Weighted average	0.772		Weighted average	0.049

a. 164/
b. 165/

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Table 17

Estimated Amount of Pyrites Recovered from Coal in the Moscow Basin and the Donets Basin in the USSR
1950-55

Thousand Metric Tons

Year	Production of Coal in the Moscow Basin a/	Pyrites Recovered	Production of Coal in the Donets Basin b/	Pyrites Recovered
1950	29,850	230.4	96,000	47.0
1951	32,000	247.0	103,500	50.7
1952	33,100	255.5	107,600	52.7
1953	34,500	266.3	114,500	56.1
1954	36,000	277.9	122,000	59.7
1955	38,500	297.2	130,000	63.7

a. 166/
b. 167/

Table 18

Estimated Amount of Sulfur Recovered from Coal in the Moscow Basin and the Donets Basin in the USSR
1950-55

Year	Amount (Thousand Metric Tons) Moscow Basin	Donets Basin	Total	Sulfur Content 30 Percent
1950	230.4	47.0	277.4	83.2
1951	247.0	50.7	297.7	89.3
1952	255.5	52.7	308.2	92.4
1953	266.3	56.1	322.4	96.7
1954	277.9	59.7	337.6	101.2
1955	297.2	63.7	360.9	108.2

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d. Mined Elemental Sulfur.

Estimates of the production of mined elemental sulfur have been given in Table 2,* which also indicates the sources for 1950-53. Similar data are not available for 1954 and 1955. In order to extend the production series to 1955, estimates of production in 1954 and 1955 were obtained by relating the production of sulfur to the increase of gross production of industry. Production of mined elemental sulfur for 1954 was 124,000 tons, an increase of 13 percent over 1953, 168/ and reflects the increase of gross production of industry as a whole of 13 percent over 1953 and the estimated increase of production of sulfuric acid in 1954 over 1953. 169/ The same percentage increase of 13 percent was applied to the 1954 total to obtain the estimate of production of sulfur.

For the 1955 estimate, in addition to the increase of gross production of industry of 13 percent, an announced increase of 21 percent for mineral fertilizers for the first half of 1955 was considered. 170/ Inasmuch as a large part of the native sulfur produced is utilized for agricultural dusting, 171/ the increased fertilizer production presupposes larger crops and an increased dusting of these crops.

e. Byproduct Sulfur from Processing Petroleum.

Although the natural crude petroleums from the Ural-Volga, Central Asia, Pechora, and Sakhalin Island fields all have moderately high sulfur contents, only the Ural-Volga fields are considered, because the quantity of crude oils produced in the other fields is relatively small.

The natural crude oils of the Ural-Volga fields have a sulfur content of 1.25 to 4.8 percent by weight of sulfur with an average of 2.2 percent. 172/ In processing the average crude oils from these fields, 45 percent of the total sulfur is concentrated in the residual 25 percent of the oil stock. The production of natural crude oil in the Ural-Volga field in 1955 is estimated to be 33.5 million tons. With an average sulfur content of 2.2 percent, the total sulfur present in these crude oils amounts to 737,000 tons. Because of the lack of the necessary technical information in practically all aspects of the various problems involved, conclusions as to the probable production of sulfur from the 1955 production of natural crude oil are based on the following approximate correlations.

* P. 10, above.

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Assuming that the principal conversion refining operations were confined to thermal visbreaking of residues and that the thermal types of cracking and reforming were applied to the distillate stocks (gas oils and naphthas), probably no more than 10 percent of the total sulfur would have been recovered as a byproduct if the refining had been for maximum yields of gasolines, and probably no more than 5 percent of the total sulfur would have been recovered as a byproduct if the refining had been for maximum yields of middle distillates such as kerosines and various types of diesel fuels. It is probable, therefore, that no more than 50,000 tons, less than 7 percent of the total sulfur, were recovered as a byproduct of refining operations. 173/

2. Estimates of Sulfur Reserves.

a. Unmined Elemental Sulfur.

The latest available estimate on unmined reserves of elemental sulfur in the USSR was presented in 1951. 174/ The reserves reported from the various deposits, however, are estimated to range in date from 1946 through 1950. For purposes of this report, 1948 has been selected as the date of the estimate of elemental sulfur reserves. The estimate of reserves of unmined elemental sulfur in the USSR in 1948 is shown in Table 19.* Using 1948 as a basis, the estimate was obtained by subtracting the total production of mined elemental sulfur in 1948-55 from the 1948 reserve total. 175/

The total estimated production of elemental sulfur in the USSR in 1948-55 is 844,000 tons.** Subtracting this quantity from the 1948 reserve estimate yields the 1955 reserve estimate of 33,735,000 tons.

b. Sulfur in Ural-Volga Petroleum Fields.

The Ural-Volga area is the major area in the USSR which produces natural crude oils whose sulfur contents exceed 0.5 percent by weight. 176/ Total proved reserves of crude oil in the Ural-Volga fields at the close of 1955 have been estimated at 769 million tons. 177/ With an average sulfur content of 2.2 percent, the total sulfur available in these crudes amounts to about 16.9 million tons.

* Table 19 follows on p. 42.

** See Table 2, p. 10, above, and Appendix A for source of the production totals for the 1950-55 period and add 85,000 tons each year for 1948 and 1949.

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Table 19

Reserves of Unmined Elemental Sulfur in the USSR
1948

Location	Sulfur Ore (Thousand Metric Tons)	Sulfur Content (Percent)	Elemental Sulfur (Thousand Metric Tons)
Volga area	200,000	11	22,000
Chokur-Koyash	100	15	15
Kkhuit	80	20	16
Gaurdak	10,000	12 to 15	1,350
Shikh	1,200	50	600
Kara Kum	5,000	30	1,500
Shor-Su	650	15	98
Kushka	5,000	30	1,500
Gazgan, Kyzyly, Kenimekh	25,000	30	7,500
Total	247,030		34,579

c. Production Forecast, 1956-60.

The estimate of the annual production of sulfur for the 1956-60 period was obtained by multiplying the 1955 production estimate by 65 percent, adding this quantity to the 1955 production, and using this latter total as the 1960 production of sulfur. Using a straight-line projection, the production of sulfur in the 1956-60 period was calculated.

d. Sulfur in Iron Pyrites in Coal.

The sulfur content of the coals in the USSR varies greatly. 178/ The recoverable sulfur occurs in the form of iron pyrites, which are known to have been recovered on a commercial scale only in the Donets and Moscow Basins. 179/ Some of the coals on the western slopes of the Urals are also classed as high-sulfur coals, but figures on coal reserves for the area are not sufficiently detailed to provide a figure

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covering the high-sulfur coals. The latest available figures on coal reserves are the 1937 totals of 88,872 million tons for the Donets Basin and 12,400 million tons for the Moscow Basin. 180/ The recoverable sulfur content in the Donets coals is reported at 1.5 percent of the total reserves, 181/ and in the Moscow Basin the recoverable sulfur is 0.6 percent. 182/ To obtain a sulfur reserve estimate for these two Basins, the production of coal for the 1937-55 period was subtracted from the 1937 reserve total as follows:

	Metric Tons	
	Donets Basin	Moscow Basin
1937 coal reserve	88,872,000,000	12,400,000,000
1937-55 total production	1,503,857,000	412,637,000
1955 coal reserve	87,368,143,000	11,987,363,000
1955 sulfur reserve	1,310,522,145	71,924,178

Because the 1937 figure for coal reserves in the Moscow Basin was made when only 6 percent of the field had been prospected, the coal reserve and sulfur reserve figures must be considered minimum figures. 183/ Thus the estimated unmined sulfur reserve in coals in 1955 is 1,382,446,323 tons.

e. Sulfur in Sulfide Ores.

Pyrites associated with sulfide copper, lead, and zinc ores account for most of the sulfur in this type of sulfur reserve. Combined sulfur in these ores makes up the remaining small percentage of sulfur reserve from this source. 184/

The copper and iron pyrites and the combined sulfur in the copper, lead, and zinc sulfide ores of the Urals area are believed to be the largest sources of sulfur reserves of the pyrite type. The Urals is also the only region for which any reserve figures are available, 185/ but the latest available estimate of sulfur reserves in the Urals area deposits is for 1937. 186/

Copper reserves in the USSR in 1939 were estimated at 19.5 million tons of metal. 187/ In 1937, 15.97 percent of the total copper reserves were reported to be in the Urals area. 188/ Assuming

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that the distribution of reserves in 1939 approximated that in 1937, the Urals can be credited with about 3.1 million tons of copper reserves in 1939. It is estimated that between 1939 and 1955 about 2.2 million tons of copper metal were extracted from these ore reserves, leaving about 0.9 million tons. As indicated in Table 11,* about 64 tons of ore from the Urals area are required to yield 1 ton of metal. The minimum reserves of ore at the close of 1955 are calculated, therefore, to have been about 57.6 million tons. Assuming that 10 percent of the ore is convertible to copper concentrates, that the pyrite content of the tailings is 60 percent, and that the sulfur content of the pyrites is 30 percent, the minimum reserve of sulfur in the copper ores of the Urals was about 9.3 million tons at the close of 1955.

The 9.3 million tons of sulfur constitute only a minimum because exploration in the Urals region since 1939 must have resulted in additions to reserves. There are, moreover, sizable deposits of pyrite ores not accounted for in the methodology presented above. These ores also contain large quantities of sulfur, but their copper content is so low that they would not be counted in the copper reserve figures.

It will be noted that only the production of copper in this area has been considered in calculating the pyrites reserves. The lead and zinc production has not been included, because of insufficient data on which to base an estimate.

3. Estimates of Domestic Demand for Sulfur.

Estimates of the total sulfur consumed in the USSR for each of the years in the series was made by US analogy. In the US in 1950, about 88 percent of the sulfur consumed was used in the manufacture or processing of sulfuric acid, sulfite pulp, carbon disulfide, and rubber. 189/ The amount of sulfur consumed for these purposes in the USSR has been estimated by assuming that 88 percent of the total sulfur consumed in the USSR is used for these purposes. It is to be noted that this estimate is not based on factors of sulfur supply.

* P. 33, above.

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a. Estimated Sulfur Consumed in the Production of Sulfuric Acid, 1950-55.

Soviet production of sulfuric acid for 1950-53 has been estimated as follows 190/:

Year	Thousand Metric Tons
1950	2,040
1951	2,280
1952	2,500
1953	2,750

On the basis of an average of the announced results of fulfillment of the 1954 Plan* for (1) the increase of gross production of industry as a whole (13 percent over 1953) and (2) the increase of the production of mineral fertilizer (16 percent over 1953), a 1954 estimate of 3.15 million tons of sulfuric acid is obtained (14.5 percent over the production in 1953). The estimate for 1955,** 3.69 million tons of sulfuric acid (17 percent over 1954), is based on an average of (1) the increase in gross output of industry as a whole achieved for the preceding year (13 percent) and (2) the increase of 21 percent announced for mineral fertilizers for the first half of 1955. It is assumed that 21 percent was also the increase achieved for the year. A consumption coefficient of 0.36 ton of sulfur per ton of sulfuric acid produced 191/ was used to obtain the total sulfur requirements for the manufacture of sulfuric acid.

b. Estimated Sulfur Consumed in the Production of Sulfite Pulp, 1953.

It is estimated that 1.1 million tons of sulfite pulp were produced in the USSR in 1953. 192/ The reported US consumption of sulfur per ton of sulfite pulp is 220 to 300 pounds. 193/ Assuming that a similar quantity would be valid for the USSR, it is estimated that 143,000 tons of sulfur were consumed in the production of sulfite pulp

* Increases reported by the State Plan fulfillment announcements are compiled in Table 20, p. 49, below.
** Subject to change in accordance with publication of the State Plan fulfillment announcement for 1955.

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in 1953. With the production of sulfite pulp closely paralleling the production of paper in the USSR, the increases reported for paper from 1951 to 1955 (see Table 11*) may be used to estimate consumption of sulfur for production of sulfite pulp.

c. Estimated Sulfur Consumed in the Production of Carbon Disulfide.

The requirements of sulfur for the production of carbon disulfide in the USSR were based on the following:

(1) Estimated rayon production in the USSR from 1950 to 1953 was 34,000, 42,000, and 66,000 tons, respectively. 194/ A 1954 estimate of 82,000 tons is obtained by applying to the 1953 production the average annual increase of about 25 percent for 1950-53.

(2) A US consumption coefficient of 0.38 ton of carbon disulfide required per ton of viscose rayon. 195/

(3) An assumption (based on the US use pattern for carbon disulfide in 1947, when 66 percent of the production was used in the manufacture of rayon 196/) that about 70 percent of the carbon disulfide produced in the USSR is used in the manufacture of rayon.

(4) The theoretical amount of sulfur required in the manufacture of carbon disulfide from carbon and sulfur of 0.842 ton sulfur per ton of carbon disulfide. 197/

d. Estimated Sulfur Consumed in the Production of Rubber.

The amount of sulfur consumed in the production of rubber in the USSR was calculated on the basis of 3 percent 198/ of the estimated consumption of new rubber for the 1950-55 period. 199/

e. Other Consumers.

The amount of sulfur used by other consumers in the USSR was assumed to be the difference between the total amount consumed and the amount consumed by the known consumers. The quantity resulting probably was used for the production of such miscellaneous items as dyes, matches, explosives paints, and insectofungicides.

* P. 33, above.

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f. Estimated Use Pattern of Sulfuric Acid in the USSR, 1950-55.

(1) Superphosphate.

Soviet production of superphosphate in 1950, 1951, 1952, and 1953 has been estimated at 1.62 million, 1.74 million, 1.88 million, and 2.04 million tons, respectively. The estimated production in 1954 of 2.365 million tons is based on the reported increase for superphosphate in 1954 of 16 percent over 1953. 200/ The estimated production in 1955 of 2.862 million tons is based on the increase reported for mineral fertilizers for the first half of 1955 (21 percent) and on the assumption that this will also be the yearly increase. The amount of sulfuric acid consumed for superphosphate production is based on the reported approximate requirement of 1 ton of sulfuric acid per 3 tons of superphosphate produced. 201/

(2) Petroleum.

It is estimated that in 1950 420,000 tons of sulfuric acid were consumed in the USSR by the petroleum industry. 202/ Based on reported yearly increases of the production of oil from 1950 to 1954 of 12 percent annually, and assuming the 1955 increase over 1954 will be the same as that reported for the first half of 1955 (19 percent), the sulfuric acid consumed by the petroleum industry in 1950-55 is estimated as follows: 1950, 420,000 tons; 1951, 470,000 tons; 1952, 526,000 tons; 1953, 590,000 tons; 1954, 600,000 tons; and 1955, 785,000 tons.

(3) Coke Chemicals (Including Byproduct Ammonium Sulfate).

It is estimated that in 1954 480,000 tons of sulfuric acid were consumed in the USSR for the production of coke chemicals and byproduct ammonium sulfate. 203/ Assuming that this input varies directly with the estimated production of byproduct ammonium sulfate in the USSR from 1950 to 1954, 204/ the sulfuric acid consumed by the coke-chemical industry for the years 1950-54 is estimated as follows: 1950, 313,000 tons; 1951, 357,000 tons; 1952, 407,000 tons; 1953, 444,000 tons; and 1954, 480,000 tons.

The consumption estimated above for 1953 and 1954 shows an 8- to 9-percent annual increase. The 1955 estimate of 518,000 tons of sulfuric acid consumed in the production of coke chemicals is obtained by assuming that the increase in 1955 over 1954 will be about 8 percent.

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(4) Steel.

It is estimated that the Soviet steel industry consumed 70,000 tons of sulfuric acid in 1950. 205/ Assuming that this input has increased at the same yearly rates reported for the production of steel in 1950-54 (see Table 11*) and by further assuming that the increase in 1955 above production in 1954 will be the same as that reported for the first half of 1955, the amounts of sulfuric acid consumed by the steel industry in 1950-55 are estimated as follows: 1950, 70,000 tons; 1951, 80,000 tons; 1952, 88,000 tons; 1953, 97,000 tons; 1954, 105,000 tons; and 1955, 115,000 tons.

(5) Viscose Rayon.

The estimates for the consumption of sulfuric acid in the production of viscose rayon in the USSR are based on the following estimates of the production of rayon in 1950-55: 1950, 34,000 tons; 1951, 42,000 tons; 1952, 55,000 tons; 1953, 66,000 tons; 1954, 82,000 tons; and 1955, 102,000 tons. A consumption coefficient of 1.48 tons of sulfuric acid per ton of rayon was applied to these figures. 206/

The reported production of selected commodities in the USSR as a percentage of production of the preceding year for 1951-55 is shown in Table 20.**

* P. 33, above.
** Table 20 follows on p. 49.

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Table 20

Reported Production of Selected Commodities in the USSR as Percentage of Production of the Preceding Year 1951-55

Commodity	1951 a/	1952 b/	1953 c/	1954 d/	1955 e/
Oil	112	112	112	112	119
Paper	112	109	110	110	104
Steel	115	110	110	108	110
Mineral fertilizer				116	121
Industry as a whole				113	

a. 207/
b. 208/
c. 209/
d. 210/
e. 211/ First half of 1955 as a percentage of the first half of 1954.

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APPENDIX B

GAPS IN INTELLIGENCE

As indicated in the body of this report, most Soviet sulfur is of byproduct origin and hence is seldom mentioned in Soviet literature. There are, consequently, a large number of gaps in intelligence on most aspects of sulfur in the USSR. The following are considered to be the most significant ones:

1. Production.

Quantitative data on the production of the sulfur raw materials that account for more than 90 percent of the total production of sulfur in the USSR are not available. The type of information available on these raw materials does not specify whether the product is in the form of sulfuric acid, elemental sulfur, or sulfurous gas. Moreover, primary data on the yields of sulfuric acid and elemental sulfur from the processing of pyrites and the combined sulfur in nonferrous sulfide ores, the major source of sulfur in the USSR, and byproduct sulfur from the refining of crude petroleum stock are not available. As a result, estimating the production of sulfur requires indirect methodologies and unverified assumptions.

2. Domestic Demand.

Soviet statistical data on the annual domestic demand for sulfur and the quantities required for the manufacture of sulfuric acid, or any of the other uses of sulfur, are not available. As a result, the estimates of demand for sulfur and sulfuric acid are based largely on US analogy.

3. Inputs.

Because most of the sulfur or sulfur equivalent produced in the USSR is a byproduct of the processing of sulfide ores, data on such inputs as power, fuel, labor, and capital investment are not available.

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4. Prices.

Soviet price data are adequate for only elemental sulfur for 1950. Prices for pyrites consumed in the production of most of the byproduct sulfur are lacking entirely.

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APPENDIX C

SOURCE REFERENCES

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

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1. American Institute of Mining and Metallurgical Engineers. "Sulfur and Pyrites," Industrial Minerals and Rocks, 1949, p. 1,008, 1,009. U. Eval. RR 1.
2. Commerce. Foreign Commerce Yearbook, 1948, Washington, 1950, p. 191. U. Eval. RR 1.
3. NIS 26, USSR, sec 63, May 51, p. 63-97. C.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

4. CIA. CIA/RR 25, The Sulfuric Acid Industry in the USSR, 29 Oct 53, p. 13. S/US ONLY.

25X1A 5. [redacted]

6. CIA. CIA/RR 25 (4, above).
CIA. CIA/RR PR-24, The Soviet Bloc Position in Pyrites, 6 Feb 53, p. 10. S.

7. Interior, US Bureau of Mines. Minerals Yearbook, 1952, Washington, 1955, p. 982. U. Eval. RR 1.
The New York Times, 3 Jan 56, p. 58 C. U. Eval. RR 2.

8. American Institute of Mining and Metallurgical Engineers. "Sulfur and Pyrites" (1, above), p. 1,010. U. Eval. RR 1.

25X1A 9. [redacted]

10. CIA. CIA/RR 25 (4, above), p. 29. S/US ONLY.

25X1A [redacted]

11. CIA. CIA/RR 25 (4, above), p. 29. S/US ONLY.

25X1A 12. [redacted]

13. USSR, United Geological Prospecting Service of the USSR, Scientific, Technological, Geological, and Prospecting Publication Office. Mineral Resources of the USSR, Leningrad/Moscow, 1933, p. 43-44. U. Eval. RR 2.

25X1A [redacted]

14. Ibid.

25X1C 15. [redacted]

16. CIA. FDD Special Translation no 182, 30 Sep 48. C. Eval. RR 3.

25X1A [redacted]

17.
18. Ibid.
19. Ibid.
20. Ibid.
21. Ibid.
22. Ibid.
23. Ibid.
24. Ibid.
25. Ibid.

25X1C 26. [redacted]

25X1A 27. [redacted]

28.

25X1C 29. [redacted]

30. Ibid.
31. Ibid.
32. Ibid.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

25X1A
33. [redacted]
25X1C 34. [redacted]
25X1A 35. [redacted]
25X1C 36. [redacted]
37. Ibid.
38. CIA. FDD Special Translation no 182, 30 Sep 48. C. Eval. RR 3.
25X1A
39. [redacted]
40. CIA. CIA/RR 25 (4, above).
41. [redacted]
25X1A
CIA. CIA/RR 25 (4, above), p. 48-49. S/US ONLY.
42. CIA. FDD Special Translation no 182, 30 Sep 48. C. Eval. RR 3.
25X1A [redacted]
43. NIS 26, USSR, sec 63, May 51, p. 63-98, 63-99. C.
25X1A [redacted]
44. NIS 26, USSR, sec 63, May 51, p. 63-98, 63-99. C.
25X1A [redacted]
45. Ibid.
46. [redacted]
25X1A
47. [redacted]
48. West Germany. Chemische Industrie, no 9, Sep 53. C. Eval. RR 2.
25X1A [redacted]
49. Ibid.
50. Ibid.
51. NIS 26, USSR, sec 63, May 51, p. 63-99. C.
52. Ibid.
53. Ibid.
54. Ibid.
55. Ibid.
56. Ibid., p. 63-98. C.
57. Ibid.
58. Ibid., p. 63-99. C.
25X1A 59. [redacted]
60. NIS 26, USSR, sec 63, May 51, p. 63-99. C.
25X1A 61. [redacted]
62. [redacted]
NIS 26, USSR, sec 63, May 51, p. 63-98, 63-99. C.
63. Ibid.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

64. NIS 26, USSR, sec 63, May 51, p. 63-98. C.
65. Ibid.
25X1A 66. [redacted]
67. Ibid.
68. Ibid.
25X1A [redacted]
CIA. FDD Special Translation no 149, 21 May 48. C. Eval. RR 3.
25X1A [redacted]
69. Ibid.
25X1A 70. [redacted]
71.
25X1C [redacted]
72. Ibid., no 120, 20 Jun 53. S. Eval. RR 3.
STATSPEC [redacted]
25X1A 74. [redacted]
75.
76. Planovoye khozyaystvo, no 6, 1955, p. 59-60. U. Eval. RR 2.
STATSPE [redacted]
78. Ibid., p. CC 12. OFF USE. Eval. RR 3.
25X1A 79. [redacted]
STATSPEC [redacted]
Ugol', no 4, 1956, p. 1. U. Eval. RR 2.
Ibid., no 1, 1951, p. 2. U. Eval. RR 2.
25X1A 81. [redacted]
82. Interior, US Bureau of Mines. RI-4972, Analysis of Tipple and Delivered Samples of Coal, Oct 53. U. Eval. RR 1.
83. Ibid., Bulletin no 556, 1953, p. 2. U. Eval. RR 1.
25X1A 84. [redacted]
85. Interior, United States Geological Survey (USGS). Short Summary Geologic Report on the Ural-Volga Region with Emphasis on the Geology of the Oil and Gas Deposits, 1954, p. 90. U. Eval. RR 2. (hereafter referred to as Interior, USGS. Short Summary Geologic Report.
86. CIA. CIA/RR 61, Petroleum Resources of the Ural-Volga Area of the USSR, 15 Aug 55. S/NOFORN.
87. Oil and Gas Journal, 21 Mar 55. U. Eval. RR 2.
88. CIA. FDD Special Translation no 182, 30 Sep 48. C. Eval. RR 3.
CIA. CIA/RR 28, Solid Fuels in the USSR, 29 Jan 54, p. 201. S.
25X1A 89. [redacted]
90. CIA. CIA/RR 25 (4, above), p. 31-37. S/US ONLY.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

91. NIS 26, USSR, sec 63, May 51, p. 63-98. C.
25X1A 92. [redacted]
93. State, Belgrade. Dsp 388, 31 Jan 54. C. Eval. RR 3.
State, Teheran. Dsp 442, Jan 54. C. Eval. RR 3.
25X1A [redacted]
94. CIA. CIA/RR PR-24 (6, above), p. 1. S.
95. [redacted]
25X1A 96.
97.
98. State, Belgrade. Dsp 388, 31 Jan 54. C. Eval. RR 3.
25X1A 99. [redacted]
100. State, Oslo. Dsp 1549, 15 Jun 50. U. Eval. RR 3.
101. State, Teheran. Dsp 442, 22 Jan 54. C. Eval. RR 3.
102. Ibid.
25X1A 103. [redacted]
104. State, Helsinki. Dsp 70, 25 Jul 55. C. Eval. RR 3.
105. Ibid.
106. Vol'kovich, S.I. Obshchaya khimicheskaya tekhnologiya (General Chemical Technology), Moscow, 1953, p. 377. U. Eval. RR 2.
107. [redacted]
108.
109.
110.
25X1A
111.
112.
STATSPEC [redacted] E.
113. [redacted]
114.
115.
25X1A 116.
117.
118.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

119. State, Helsinki. Dsp 70, 25 Jul 55. C. Eval. RR 2.
120. Ibid.
121. State, Vienna. Dsp 95, 26 Jul 55. C. Eval. RR 2.
122. USSR. Spravochnik-tsennik na osnovnyye stroitel'nyye, tekhnicheskiye i vspomogatel'nyye materialy proizvodstvenno-tekhnicheskogo naznacheniya, instrumenty i avtozapchasti v tsenakh 1950 g (Price Handbook on Basic Construction, Technical, and Auxiliary Materials for Productive-Technical Purposes, Instruments, and Automobile Spare Parts in Prices of the Year 1950), vol 2, pt 1, Baku, 1950, p. 186, 196. U. Eval. Doc. (hereafter referred to as Spravochnik-tsennik)
123. NIS 26, USSR, sec 63, May 51, p. 63-98. C.
25X1A 124. [redacted]
125. Interior, US Bureau of Mines. Minerals Yearbook, 1950, Washington, 1953, p. 1,182. U. Eval. RR 1.
126. Spravochnik-tsennik (122, above), p. 186. U. Eval. Doc.
127. Ibid., p. 196. U. Eval. Doc.
25X1A 128. [redacted]
129. State, Munich. Dsp 275, 11 Jan 54. S. Eval. RR 2.
25X1A 130. [redacted]
131. CIA. CIA/RR 25 (4, above), p. 7. S/US ONLY.
132. Ibid.
133. Ibid., p. 26. S/US ONLY.
134. Interior, US Bureau of Mines. Minerals Yearbook, 1950, Washington, 1953, p. 1,188. U. Eval. RR 1.
135. CIA. CIA/RR 25 (4, above), p. 7. S/US ONLY.
136. Ibid., p. 27. S/US ONLY.
137. Faith, W. L., Keyes, Donald B., and Clark, Roland L. Industrial Chemicals, New York, 1950, p. 602-603. U. Eval. RR 1.
138. CIA. CIA/RR 25 (4, above), p. 17. S/US ONLY.
139. CIA. FDD AB 505401, Jun 52. U. Eval. RR 2.
140. Ibid.
25X1A 141. [redacted]
142. USSR. Godovoy obzor mineral'nykh resursov 1926 (Mineral Resources of the USSR in 1926), Leningrad, 1925, p. 286. U. Eval. RR 2.
143. Planovoye khozyaystvo, no 3, 1952. U. Eval. RR 2.
144. Kazakhstanskaya pravda, 28 Jan 49. U. Eval. RR 2.
145. Ibid.
146. Ibid., 18 Dec 55. U. Eval. RR 2.
147. Ibid.
148. [redacted]
25X1C

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

25X1C 149. [redacted]
150. Ibid.
151. CIA. CIA/RR 25 (4, above), p. 26. S/US ONLY.
152. Ibid., p. 49. S/US ONLY.
153. Yerevan kommunist, various issues, 1951-54. U. Eval. RR 3.
154. CIA. CIA/RR 25 (4, above), p. 49. S/US ONLY.
25X1A 155. [redacted]
CIA. FDD Special Translation no 182, 30 Sep 48. C. Eval. RR 3.
156. CIA. CIA/RR 25 (4, above), p. 19-21. S/US ONLY.
157. Ibid.
158. Ibid.
159. Ibid.
160. Ibid.
161. Ibid.
162. Ibid.
163. Ibid.
164. CIA. CIA/RR 28 (88, above).
25X1A 165. [redacted]
166. [redacted]
STATSPEC
Ugol', no 4, 1956, p. 1. U. Eval. RR 2.
Ibid., no 1, 1951, p. 2. U. Eval. RR 2.
167. Ibid.
168. [redacted]
STATSPEC
169. CIA. CIA/RR 25 (4, above), p. 17. S/US ONLY.
170. [redacted]
STATSPEC
171. CIA. CIA/RR 25 (4, above), p. 29. S/US ONLY.
172. Interior, USGS. Short Summary Geologic Report (85, above).
Maymim, Z.L., edr. Ob usloviyakh obrazovaniya nefti po materialam Volgo-Ural'skoy oblasti (On Conditions for the Formation of Petroleum According to Data of the Volga-Ural Region), Leningrad, 1955, p. 188. U. Eval. RR 2.
173. CIA. CIA/RR PR-135, Output of Refined Petroleum Products in the USSR, 8 Mar 56. S.
174. NIS 26, USSR, sec 63, May 51, p. 63-98, 63-99. C.
175. Ibid.
176. CIA. FDD Translation no 311, 31 Aug 51, Classification of USSR Petroleums According to Gost 912-46. C. Eval. RR 2.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

177. CIA. CIA/RR 61, Petroleum Resources of the Ural-Volga Area of the USSR, 15 Aug 55, p. 24. S/NOFORN.
178. CIA. CIA/RR 28 (88, above).
179. CIA. FDD Special Translation no 182, 30 Sep 48. C. Eval. RR 3.
25X1A [redacted]
180. CIA. CIA/RR 28 (88, above).
181. CIA. FDD Special Translation no 182, 30 Sep 48. C. Eval. RR 3.
25X1A 182. [redacted]
183. CIA. CIA/RR 28 (88, above).
25X1A 184. [redacted]
185. Ibid.
186. Balzak, S.S., Vasyutin, V.F., and Feygin, Ya.G. Economic Geography of the USSR, New York, 1949, p. 259. U. Eval. RR 1.
187. CIA. Strategic Intelligence Digest, Union of Soviet Socialist Republics, vol 2, Mar 48, p. 10-8. S. Eval. RR 3.
188. Balzak, Vasyutin, and Feygin, op. cit. (186, above).
189. Interior, US Bureau of Mines. Minerals Yearbook, 1950, Washington, 1953, p. 1,181. U. Eval. RR 1.
190. CIA. CIA/RR 25 (4, above), p. 18. S/US ONLY.
191. Ibid., p. 26. S/US ONLY.
192. FAO. Yearbook of Forest Products Statistics, Rome, 1954, p. 82. U. Eval. RR 2.
193. Perry, J.H. Chemical Engineer's Handbook, New York, 1954, p. 6-201. U. Eval. RR 1.
194. Cotton Yearbook, 1953, 48th ed, London, Jun 53, p. 679-680. U. Eval. RR 2.
195. Shreve, R.N. The Chemical Process Industries, New York, 1945, p. 726. U. Eval. RR 2.
196. Faith, Keyes, and Clark, op. cit. (137, above), p. 194. U. Eval. RR 1.
197. Ibid., p. 192. U. Eval. RR 1.
198. The Vanderbilt Rubber Handbook, New York, 1948, p. 97-137. U. Eval. RR 2.
199. CIA. ORR Project 22.860, The Rubber Industry in the Sino-Soviet Bloc (to be published).
200. Khimicheskaya promyshlennost', no 1, 1955, p. 1. U. Eval. RR 2.
201. CIA. CIA/RR 32, The Mineral Fertilizer Industry in the USSR, 20 Apr 54, p. 40. S/US ONLY.
202. CIA. CIA/RR 25 (4, above), p. 58. S/US ONLY.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

203. CIA. CIA/RR 60, Major Aromatic Chemicals in the USSR, 27 Jun 55, p. 25. S/NOFORN.
204. Ibid., p. 30. S/NOFORN.
205. CIA. CIA/RR 25 (4, above), p. 58. S/US ONLY.
206. Shreve, R.N. Selected Process Industries, New York, 1951, p. 659. U. Eval. RR 2.
207. State, Moscow, Joint Press Reading Service. Moscow Daily Press Review, no 29, 29 Jan 52. U. Eval. RR 2.
208. Ibid., no 23, 23 Jan 53. U. Eval. RR 2.
209. Ibid., no 35, 4 Feb 54. U. Eval. RR 2.
210. [redacted]
211. Ibid., 26 Jul 55. OFF USE. Eval. RR 2.

STATSPEC

Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2

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Approved For Release 1999/09/02 : CIA-RDP79-01093A001200050009-2
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