NATURAL RESOURCES OF THE SOVIET UNION

3 December 1956

CONTENTS

	Page
INTRODUCTION--Dr. M. S. Reichley, Director of Instruction, Industrial College of the Armed Forces	1
SPEAKER--Dr. Demitri B. Shimkin, Bureau of the Census, Department of Commerce	1
GENERAL DISCUSSION	19

Publication No. L57-79

INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

Dr. Demitri B. Shimkin, Bureau of the Census, Department of Commerce, was born in Omsk, Siberia, 4 July 1916. He received his education in the United States, including the B. A. and Ph. D. degrees from the University of California. Prior to World War II, Dr. Shimkin did research work at the University of California in anthropology and economic geography with emphasis on Western North America. He entered the Army on active duty in September 1941 and served with the Intelligence Division, War Department General Staff, and U. S. Forces, European Theater (1941-1946), specializing in Russian affairs. He was assigned to the National War College, 1946-1947, and lectured at the war colleges of the three services since 1947. He is a graduate of the Army's Command and General Staff School. Dr. Shimkin was a member, Institute for Advanced Study, Princeton, in 1947 and 1948. Since 1950 he has been consulting editor to Automotive Industries. He has written numerous articles on Soviet economic geography and technology as well as a volume, Minerals, A Key to Soviet Power, published in 1953. Dr. Shimkin was Research Associate of the Russian Research Center, and lecturer in Social Anthropology at Harvard University between 1948 and 1953. From July through December 1954, he was on loan to the Legislative Reference Service, Library of Congress, as a member of the task force on European Economic Trends for the Joint Congressional Committee on the Economic Report. Dr. Shimkin was on loan to the Weapons Systems Evaluation Group, Office of the Secretary of Defense, from April through July 1956.

NATURAL RESOURCES OF THE SOVIET UNION

3 December 1956

DR. REICHLEY: General Hollis, members of the class: To date we have approached our study of natural resources from the standpoint of the problems involved in planning for the security and defense not only of the United States, but also of the Free World. I believe we would be delinquent if we did not add to this study some idea of the resources position of our potential enemy. Consequently, this morning we are going to have a lecture on the resources of the Soviet Union.

Our speaker is Dr. Demitri B. Shimkin, of the Department of Commerce. From perusing his biography you have learned that he is a student, a consultant, and a writer in this field. I might add that his book Minerals, A Key to Soviet Power is considered outstanding in this area.

Dr. Shimkin, it gives me pleasure to welcome you back to the Industrial College again.

DR. SHIMKIN: General Hollis, gentlemen of the Industrial College: The problem I have this morning in discussing the material resources of the Soviet Union is one often summarized by a well-known history professor in teaching European history. About the fourth lecture he would roll up his sleeves and say: "Now we will cover the Hundred Years' War in forty-five minutes." This morning I will try to cover, not the Hundred Years' War, but the agricultural, forestry, fishery, water, and mineral resources of the Soviet Union.

Soviet natural resources as a whole can be discussed from the standpoint of physical and economic availability. The first approach will serve to bring out salient relations between resource patterns and the nation's climate, topography, and geology. The second must interrelate resource availability with changing military, political, and economic policies, all of which have profoundly affected the course of resource development in the U.S.S.R.

I. The Pattern of Soviet Resources.

Broadly speaking, the natural resources of the Soviet Union are comparable in magnitude, though not in quality, to those of the United States.

Let us first look at agricultural resources. In terms of so-called standard agricultural land, the Soviet Union has about 70 percent of the capacity of the United States. This arable land is, however, distributed over a large territory, approximately a million square miles, and largely in a long triangle, from Leningrad almost due east to Irkutsk, then west to Semipalatinsk, Stalingrad, and the Black Sea, and, finally, north along the western frontier of the U.S.S.R. Apart from this area, which encompasses almost 90 percent of the Soviet Union's agricultural resources, tillable land is found in the North Caucasus; in the Transcaucasus, especially Azerbaydzhan and Georgia; in Central Asian oases; and in limited areas of Eastern Siberia and the Far East.

The Soviet agricultural potential is severely limited by cold and dryness.[1] The northern margin of the agricultural triangle has only some 90 days of growing weather a year, and is the northern limit of spring wheat. The northern limit of fully-maturing corn, a July mean temperature above 70°F, is roughly Kishenev, Kiev, Kuybyshev, and Semipalatinsk, i.e., almost the southern margin of the agricultural triangle. At the same time, it is only to the west of Moscow, in the eastern Caucasus, and in the Far East that annual precipitation rises to 25 inches or more. In the "new lands" of Siberia and Kazakhstan it is 15 inches or less. Furthermore, killing droughts are recurrent throughout the black-earth steppe, from the southern Ukraine to the Altay. In this vast area, only 11 years between 1891 and 1949 had good moisture, while in 15 there were full-fledged droughts.

In general, the agricultural resources of the Soviet Union are most suitable for hardy grains and livestock. The areas where other crops--cotton, sugar beets, tobacco, citrus fruit, oil-bearing plants--can grow are very small indeed. For example, two-thirds of all Soviet cotton comes from an area of 5,000 square miles in the Fergana Valley. Also, the entire citrus area of the Soviet Union is in Georgia, and even this is marginal. In two recent winters--'41-'42 and '49-'50--frost practically destroyed the orchards.

---

[1]For excellent evaluations see L. Volin: A Survey of Soviet Russian Agriculture (Agriculture Monograph No. 5, U.S.D.A., Washington, 1951, pp. 1-9); also C. D. Harris: "Soviet Agricultural Resources Reappraised," Journal of Farm Economics, vol. XXXVIII, No. 2, May 1956, pp. 258-273.

The various agricultural regions of the Soviet Union present markedly different problems and developmental potentials, a fact which makes sweeping bureaucratic solutions a genuine hazard. In the black-earth steppes of the Ukraine and southeast European Russia, too little natural cover has been left, with extensive wind and water erosion, including deep gullying, being the result. Windbreaks and perennial grasses have been applicable solutions, although stress might also have been laid upon check-dams, water-ponds, and the substitution of cattle for grain. But none of these answers are very pertinent to the irrigated lands of Central Asia, where intense evaporation and shallow, subsurface salt horizons present hazards of salt infestation given excessive or improper irrigation.

In Western Siberia and Kazakhstan, where cultivation has been enormously expanded over the past three years, sound dry-farming practices are essential. Dry-land agriculture is perfectly feasible if provisions are made to accumulate moisture. In North Dakota and Montana, for example, the usual practice is to grow wheat in the same field one year out of two or three, depending on locality, while conserving moisture the rest of the time. In this way, sustained yields become possible. The present Soviet policy of cultivating practically the entire arable area of Western Siberia and Kazakhstan is extremely risky, as well as being wasteful in terms of seed and fuel.

True, the Soviets did well in 1956. The previous year was about a total failure, although the year before was good. But the success or failure of this program must be judged, not only from short-term fluctuations, but from cumulative effects on the water table (especially from water-demanding crops such as corn) and from cumulative wind erosion. Continuation of the present scale of reckless exploitation may well prove disastrous.

East of Lake Baykal, the Pacific monsoon brings abundant summer moisture--and insufficient summer heat and evaporation, especially with permanently frozen subsoils. In consequence, the ripening of crops tends to be uncertain; for example, reported yields in Birobidzhan in 1952 were 6 quintals of grain, 26 quintals of potatoes, and 24 quintals of vegetables per hectare (about 9, 39, and 36 bushels per acre, respectively). In general, Soviet agricultural expansion east of Lake Baykal has failed to keep up with the demand of a booming industrial population. The deficits are being covered, and some stockpiles are presumably being created, by Canadian shipments of wheat totalling about 3 million tons annually.

In all, Soviet agricultural resources are exceedingly heterogeneous. Because of this, and because of the vast extent and poor transportation system of the U.S.S.R., the evaluation of Russia's agricultural position must consider regional balances as well as national aggregates. From the standpoint of food, the North Caucasus and Western Siberia are the significant surplus areas; the Ukraine, the Volga, and the Urals are roughly self-sufficient; Central and Northweast Russia, the Transcaucasus and Central Asia, and Eastern Siberia and the Far East are areas of marked deficiency.

Let us now consider Soviet timber resources. In the U.S.S.R., forested areas (almost all softwoods) cover nearly 2.9 million square miles, three times the area of American forests, excluding Alaska. But this area has limited productive capacity, because short growing seasons, limited moisture, and, in many regions, permanently frozen ground lower reproductive rates. In the U.S.S.R. as a whole, annual growth is estimated to run about 1.3 percent of the volume of growing stock, compared to an average of 4.24 percent for the United States as a whole, and 6.0 percent for the South. Furthermore, the proportion of commercially accessible forest land in the Soviet Union is lower (57 percent) than in this country (74 percent).[2]

The surprising fact emerges that the capacity for sustained lumber production in the U.S.S.R. is lower than that of the United States, exclusive of Alaska. Of course, the Soviet forest area is so large that extensive net reductions in stocks could be made for a long period, as they were in this country, without basic effect, provided watersheds remained protected. On the other hand, the locations of Russia's prime forest lands, in Karelia and the basin of the Northern Dvina River, and in the basin of the Amur River in the Far East, favor exploitation for export, but introduce high transportation costs for the domestic market. Before World War II, in fact, almost a fifth of the Soviet Union's sawmill output was exported, which provided nearly 17 percent of the foreign-exchange earnings sorely needed for Soviet industrialization. In the postwar period, however, Soviet timber exports have been negligible, probably a reflection of the weakened

---

[2]See United Nations, Food and Agriculture Organizations: World Forest Resources (Rome, Italy), March 1955; and U. S. Dept. of Agriculture: Forests and National Prosperity. Misc. Pub. No. 668, Washington, 1948.

position of the industry in relation to world prices and standards, as a result of increasing technological lag and a reduced availability of forced labor for Soviet lumbering.

The fisheries resources of the Soviet Union are extensive and exceptionally important. At the present time, about one-fourth of Russia's entire animal protein and fats supply (including milk) comes from fish and sea mammals. The comparable proportion in the United States is 8 percent.

About half the catch of the Soviet Union comes from the Far East, particularly the Kamchatka Coast, the Northern Kuriles, and the Lower Amur. Expulsion of the Japanese from their prewar concessions, the acquisition of Japanese fishing areas in the Kuriles, and an expanded offshore fleet have made possible an approximate tripling of the Far Eastern catch since World War II. A continued high catch (subject to the normal fluctuations of the salmon cycle) appears possible, for the Soviet Pacific, unlike the U. S. Northwest, has not yet been affected by dam construction or industrial pollution.

Soviet northern waters, especially the Barents Sea, have become increasingly significant, for cod and herring above all, and now yield about a quarter of the Soviet catch. A very favorable development for this area has been the warming of the Atlantic Artic, which has extended the eastern limit of cod and herring by at least 700 miles since 1920. In addition, both the Far Eastern and Northern fisheries have benefited from excellent research, particularly on the effects upon breeding and growth rates of water temperatures, salinity, and phosphorous and nitrogen content.

It is only in the once-vital Black Sea-Azov-Caspian fisheries that the outlook is bad. Today, the catch in these areas is fully a third below the level of the 1930's, constituting about 15 percent of the Soviet total. Overfishing and a reduction in the volume of the Caspian from the adverse evaporation--precipitation balance of the past 35 years have been major causes. The Volga dam project and the Volga-Don canal, both of which will reduce discharge into the Caspian and Azov Seas, will accelerate this decline.

Growing needs for cheap power and transportation, for urban and industrial water supplies, and for irrigation have generated increasing Soviet concern with the development and management of the nation's surface water resources. (Except in Central and South Russia,

the study of subterranean aquifers is still in its infancy.) Although hydroelectric power, as a share of all power generated, increased only from 11.5 to 13.6 percent between 1937 and 1955, the current program, if completed on schedule, will increase this proportion sharply. Russia's developed and potential water resources are most significant in seven regions:

1. The Northwestern region, primarily associated with the heavily glaciated, old Fenno-Scandian shield of Karelia and Murmansk Oblast. This area has excellent potentials, deriving from a favorable precipitation-evaporation ratio, natural storage in lakes, and an average drop of 300-500 feet in 60 miles. The discharge is evenly distributed throughout the year, while moderately heavy snow inhibits deep freezing. Only three rivers in this area, the Svir (61°N 34°E), which supplies Leningrad; the Volkhov (59°30'N 32°10'E), powering an aluminum plant; and the Niva (67°15'N 32°30'E), which supplies the Monchegorsk nickel-copper-apatite-rare earths complex, have been largely developed, to a capacity of some 600,000 kw.

2. The Dnepr Basin may be divided into an area of water accumulation (north of 50°n) and an area of discharge and evaporation (to the south). In the northern area, the main problems are swamp drainage and reservoir construction, to open up rich, peaty soils, to regulate discharge, and to promote nevigation. Downriver, the Zaporozhye site (47°50'N 35°05'E) alone has been developed (to 650,000 kw capacity), while the Kakhovka dam and station (46° 45'N 33°30'E) are under construction, to a planned capacity of 250,000 kw. Associated canals will irrigate 3.7 million acres of rich black-earth soils in the Ukrainian and North Crimean steppes, perhaps by the 1960's. The ultimate capacity of the Dnepr is 2 million kilowatts.[3]

3. The Volga Basin, including tributaries such as the Kama, presents the most important and difficult problems in

[3]See also D. B. Shimkin: "Economic Regionalization in the Soviet Union," Geographical Review, XLII:591-614, 1952.

Soviet water management. The Basin is densely settled, with a high demand for potable, industrial, and irrigation water. It is short of fuel, and has an overloaded transport system. At the same time, moreover the stream gradients are gentle, the discharge is primarily in the spring, and evaporation presents a serious problem. Furthermore, dam sites are few, and for low structures only; adequate reservoir capacity can be created only by extensively flooding lands now under cultivation, and by increasing the flood hazard. Finally, the shrinking of the Caspian, with the destruction of its fisheries and impedance of the important oil traffic, are inevitable concomitants of intensified water use in the Volga Basin.

Despite these difficulties, the Soviets have proceeded aggressively with dam construction and power development on the Volga. The Moscow-Volga Canal and the Rybinsk reservoir (58°N 38°45'E) were completed before the war. By 1955 the Chkalovsk (56°20'N 43°45'E) and Molotov dams had been finished, although it is not certain whether their planned capacities of 400,000 and 500,000 kw, respectively, have yet been installed. Another element of the project has been the completion of the Volga-Don canal, and the associated Tsymlyanskaya reservoir and dam (47°38'N 42°5'E). Finally, the two key structures, the immense Kuybyshev (53°25'N 50°E) and Stalingrad (48°48'N 44°40'E) dams are being built. In the former, the earth and concrete work has been finished, with 2 out of some 20 projected 100,000 kw turbines reported installed. In the latter, concrete pouring is in progress; the planned capacity here is 2.3 million kw. In general, the project is already providing a sizeable fraction of its ultimate power, though little of the ambitious 400 kilovolt network that is to integrate the Volga, Moscow, the Urals, and the Eastern Ukraine has even been begun. Industrial water supplies have been augmented, a barge channel has been opened from the Donets Basin to Central Russia and the Urals, and a limited start gained in irrigation, which will ultimately add a net of 10 million acres of good soil to Soviet agriculture. In all, the Volga project, though deficient in many respects, is the Soviet Union's boldest and most constructive step in water-resource development.

4. The water resources of the Caucasus are considerable, with small watersheds being offset by heavy precipitation (60 inches and more) and steep gradients, e.g., the Kura to Khashuri (42°0'N 43°35'E) falling some 3600 feet in 60 miles. The Lake Sevan-Razdan River tunnel and cascade (40°40'N 45°0'E), the Mingechaur station and reservoir (40°50'N 47°0'E), and two stations on the Rion cascade (40°45'N 47°05'E), totalling perhaps 700,000 kw, have been developed, to power aluminum, ferroalloy, and synthetic rubber output, and to irrigate the dry lands of the Kura Valley. The hydroelectrical potential of the Transcaucasus, however, approaches 17 million kw.

5. In Central Asia and Western Siberia, the stream systems--from the Amu Darya to the Yenisey--rise in very high, glaciated mountains with immense water resources that have been barely scratched. The most significant developments to date have been the Stalin canal and Farkhad dam (40°15'N 69°12'E) on the Syr Darya. The first diverts water from the Naryn river (41°N 72°E) to the piedmont slopes of the Fergana Valley while the second is further downstream. The two together have served to stabilize and expand cotton production in the Fergana Valley, which provides two-thirds the Soviet total. In addition, the Farkhad station has 130,000 kw capacity, to serve the needs of the Tashkent industrial and atomic-energy complex. That is also powered by the short, steep Chirchik river cascade, due north of Tashkent.

   On the other major rivers, the most important power development finished to date is the Ust' Kamenogorsk station (50°N 82°20'E) on the Irtysh, power from which has permitted a technological rejuvenation of the crucially important Altay lead-zinc-copper-cadmium mines. Sizeable projects are under construction at Bukhtarma (49° 40'N 83°30'E) on the Irtysh above Ust' Kamenogorsk, and south of Novosibirsk (55°N 83°E) on the Ob'. The latter station is to have 400,000 kilowatts capacity.

6. The Angara River is characterized by both a moderate drop--450 feet in 400 miles between Lake Baykal and Bratsk (56°10'N 102°10'E)--and by a moderate discharge (1716 m^3/sec, 20 percent that of the Volga at Stalingrad).

However, the availability of both Lake Baykal as an immense reservoir and of several good, hard-rock dam sites has encouraged the Soviets to undertake an ambitious set of hydroelectric projects. Concrete-pouring on the first, above Irkutsk (53°15'N 104°30'E) is ending; this has a head of some 90 feet, and a projected capacity of 660,000 kw. The second, below Bratsk, is to be a high-level dam, with a base 1,000 yards wide, a maximum breadth of 5,500 yards, and a planned capacity of 3 million kw. Its completion is many years in the future.

7. Finally, the Amur River and its tributaries, characterized by fair precipitation, little evaporation, moderate gradient, and numerous dam sites, remain completely undeveloped. However, recent information[4] reports a long-term Russo-Chinese agreement on a 13-million-kilowatt-capacity program of development in this basin.

In sum, Soviet water resources are large and little developed. The present program is largely oriented toward power, both from cascades of low-level dams and high-level dams; the relative cheapness of hydroelectricity (a cost one-fifth that of thermal, according to 1954 Soviet calculations) is a major consideration. Output has, in general, been maximized by large reservoirs and maximum discharge, at the expense of irrigation and flood control, and to minimize the need for standby thermal plants.

Let me turn now to Soviet mineral resources. I have discussed these elsewhere in detail[5] and will undertake now merely to summarize the general position of the U.S.S.R. and to indicate some major developments of the past five years. In general, the mineral wealth of the Soviet Union, as presently known or inferred, approximates that of the United States. Both countries have enormous reserves of coal, lignite, magnesium salts, salt, potash, phosphate rock, and low-grade sulfur basics. Soviet reserves far exceed the American in asbestos, chromite, manganese, mercury, nickel, possibly petroleum, and tin. Copper reserves are roughly equal. The Soviet position in bauxite,

---

[4] H. Schwartz in New York Times, 22 August 1956.

[5] D. B. Shimkin: Minerals. A Key to Soviet Power (Harvard University Press, 1953).

borax, cadmium, helium, iron ore, lead, molybdenum, titanium, tungsten, vanadium, and zinc is far weaker than that of the United States. Above all, the location of Russia's minerals is far less favorable in relation to one another or to markets. In general, the Soviet Union west of 60°E has the overwhelming bulk of the country's iron ore and petroleum. The national coal and lignite resources rest, in a comparable proportion, east of this line. Over two-thirds of Soviet copper, lead, and molybdenum reserves are found in Kazakhstan and Central Asia, while Soviet tin and tungsten come from east of Lake Baykal.

Among the major developments since 1950 has been the discovery of diamond-bearing placers and pipes on the Lower Tunguska River, presumably in the area of ultra-basic intrusion near Zhdanov (60°10'N 108°0'E). Also, the Soviet copper position has been strengthened by the discovery of a copper-zinc deposit, reportedly third in size after Dzhezkazgan and Kounrad (hence, with 1 to 2 million tons of copper metal content) at Nikolayevskoye (?49°10'N 82°0'E). This should more than offset the untimely depletion of the Urals copper mines, which has taken place as the result of enormous underground, pyrite fires over the past decade. In contrast, Soviet bauxite resources now seem even weaker than estimated earlier, since the U.S.S.R. is placing heavy emphasis upon nepheline, a high-silica, low-alumina rock, in its expansion of aluminum output. The old Volkhov plant (59°30'N 32°10'E), which utilized nearby Tikhvin bauxite before World War II, is now operating on nepheline from the Kola Peninsula. Furthermore, the new alumina plant at Achinsk (56°15'N 90°30'E) will process nepheline from Uzhur (55°40N 89°50'E) and other deposits. Aluminum from this source will allegedly cost 25 percent less than that produced at Zaporozhye (47°50'N 35°05'E). presumably from Hungarian bauxite.

Soviet coal and lignite reserves have been expanded by discoveries in southern Yakutiya and the western Ukraine. The former field, evidently associated with Jurassic formations near Chulman (ca. 57°N 125°E) is reported to include coking grades in quantity; hope of a viable steel industry in the Soviet Far East has correspondingly revived. The Ukrainian deposit, a Cretaceous deposit centering near Chervonograd (50°30'N 24°25'E), appears smaller but immediately more important in view of western U.S.S.R. fuel deficits. Development has already started; 1960 output is to be some 18 million metric tons.

In iron ore, the successful prospecting of very extensive (but apparently low grade) magnetite deposits in northwest Kazakhstan

(ca. 51°N 63°E) is of crucial importance to the steel industries of Magnitogorsk (53°25'N 59°05'E) and Chelyabinsk (55°10'N 61°25'E), where accessible local ores have been largely depleted. Though unquestionably more costly than Magnitogorsk ore, the new supplier will not require conversion to basic-process furnaces, as would have been the case with ores from Ayat (51°50'N 62°20'E), the major unexploited deposit known 10 years ago. This development is also vital to Western Siberia, still dependent upon imported iron ore.

To summarize, the magnitude of Soviet natural resources is substantial, with both recent discoveries and technological advances presenting excellent promise for further expansion. Nevertheless, when these resources are related to the size of Russia's population and industrial output, when the problems of resource balance, quality, and distribution peculiar to the Soviet Union are taken into account, it then becomes clear that competent resource management is crucially important to the Soviet economy. To what degree has it been achieved?

II. Soviet Resource Management: Policies.

Soviet resource development has been governed primarily by explicit governmental policies, plans, and decrees, rather than by market demands or public sentiments. The guiding philosophy has been to concentrate all efforts on a limited range of specified objectives to be achieved in the near future, with longer-range and secondary considerations, e.g., recreational values in forest areas, being virtually disregarded. The initiation and direction of key programs is entrusted to high Communist Party authorities, with immense powers of execution. The basic means used in carrying out programs are priorities in capital and personnel, subsidies, sales taxes up to several hundred percent to control undesired consumption, direct controls on resources allocation, and the pressures of propaganda and police coercion. In general, incentives through higher wages have sharply increased in importance since Stalin's death and the marked diminution of slave labor. Direct controls have remained most significant in agriculture, the collective farmer, for example, not being able to leave agriculture without official permission. Also, the authority of the Machine-Tractor Stations over the collective farms has been widened markedly. And the corvee--six days' compulsory work on the roads by all able-bodied rural men (18-45) and women (18-40)--is still in force.

The central policy of Soviet resource development over the past 30 years has been the maximum strengthening of that nation's

immediate military-economic potential. A significant facet of that policy has been the forced-draft acceleration of minerals output, especially steel and fertilizer basics (for ammunition) and nonferrous metals. Since World War II, the mechanization of the Soviet army has necessitated especially rapid increases in petroleum output. In the timber industries, cellulose output has been greatly stressed. Another facet has been emphasis upon the convertibility of civilian equipment to military use. Soviet factories have long been adapted (through mobilization staffs, educational orders, and set procedures) to conversion to military output, e.g., ammunition production in agricultural-machinery plants in World War II. Furthermore, much civilian equipment, e.g., agricultural and engineering tractors and jeeps, is designed to military specifications and subject to mobilization. The costs of excessive weight and similar unadaptive features are borne by the civilian economy.

Another keynote of Soviet policy has been self-sufficiency, even though this has meant the exploitation of marginal resources (e.g., tin in the Soviet Far East), extensive substitution, or extreme restriction of use in nonvital sectors. At the same time, stockpiling has been an essential element of Soviet economic operations, particularly in nonferrous metals, before and, via Lend Lease, during World War II.

Also, the Soviet Union has given priority, since the mid-1930's, to the development of its strategic heartland, between the Volga and Yenisey Rivers. The intensive development of mining and metallurgy in Kazakhstan, the great expansion of agriculture in Western Siberia and North Kazakhstan, and the rise of petroleum production on the western slopes of the Urals are all expressions of this priority. So too has been the relative neglect of Russia's western frontiers and the Transcaucasus. Finally, mention should be made of Soviet efforts, up to Stalin's death, to create forward logistical bases in Eastern Europe and Manchuria.

The Soviet Union has always been short of capital. As a result, it has practiced extreme and even excessive austerity of resource inputs in secondary areas of effort. Manpower alone has been regarded as a virtually free commodity, a viewpoint which will become increasingly untenable as the effects of World War II impinge upon the Soviet labor supply.

The Soviet economy of capital has had many expressions. In general, the Russians have strongly preferred investment alternatives

that are initially cheaper and more quickly brought into production, despite disadvantages in long-term efficiency and life. Illustrations are the employment of long-wall rather than chamber-and-piller lay-outs in coal mining, and agricultural expansion through greater acreage rather than higher investment per acre. The use of local fuels, especially lignite and peat, and of local building materials, including even reeds, has been promoted to minimize transportation inputs. Amortization too is minimized, with equipment being kept in operation as long and as intensively as possible, and with little regard for the costs of obsolescence. There is a general paucity of auxiliary equipment and supplies--ventilating systems, materials-handling systems, paint, spare parts, etc.--which again permits maximum output at the cost of productivity and durability. Also, scarcities often induce marked lowering of standards. During the Korean war, secondary, zinc-adulterated, aluminum was used for automotive engines. During the last decade, the inputs of steel per unit of construction have been drastically reduced by substituting concrete-block, wall-bearing for steel-frame designs. Finally, the Soviets have not been loathe to sacrifice civilian welfare to industrial ends. For example, a substantial fraction of the country's potato crop still goes into synthetic rubber output, despite the nation's need for food and fodder. Illustrative too have been Soviet refusals to abate smog nuisances generated by power stations burning high-ash, high-sulfur fuels--the cost was too high. At the same time, many significant engineering solutions to other Soviet paucities of capital resources have been achieved. The nation's supply of pots, pans, and cutlery is a by-product from the scrap of the aviation industry. Significant progress has been realized in extracting coal-tar products from peat and lignite. Other illustrations may be cited; however, they are still far outbalanced by instances of "doing without."

Much of the economy so painfully achieved is dissipated by indulgence in vainglorious superprojects which reflect the whims of Communist Party leaders. Some of these, such as the incredible Baykal-Amur railroad scheme before the war, and the Turkmen (Amu Darya-Caspian Sea) enterprise of 1950-53, were completely abortive, having to be abandoned after heavy expenditures. Others, such as the forest shelter-belt project and Khrushchev's expansion of corn acreage, have represented sound concepts expanded to absurd limits. Still others, such as the immense effort devoted to the Angara hydroelectric and allied undertakings, freeze resources on long-term, risky programs when capital is scarce for more urgent needs, e.g., completion of the Volga and Dnepr projects or the stabilization of Urals metallurgy. In general, Communist Party policies represent the costliest aspect of Soviet resource management.

III. Soviet Resource Management: Results.

To what extent have the Soviets been able to expand raw materials production, and at what cost? Let us examine briefly agriculture and mining, which represent major sectors dominated by contrasting policies, the former with an emphasis upon resource economies and the latter stressing growth in output.

In comparison with the United States, Soviet agriculture is characterized by major structural differences and by extreme inefficiency. Organizationally, the contrast is between a curious coexistence of State plantations and peasant gardens, on the one hand, and family farms, on the other. The collective farmer, furthermore, is subject to onerous dictation, unable to leave without official permission, forced to begin work at 12 years of age, regulated in the direction and quantity of his or her labor, and pressed constantly to give up the private plot--the veritable foundation of the peasant household. True, significant concessions in price rises and tax reductions have been given Soviet farmers since 1953, but the essential contrast between the U.S.S.R. and U.S. is still one of virtual serfdom opposed to freedom. Even more, the Soviet Union cannot pay for these and other concessions to consumers without abandoning projects central to its military-economic goals, and may well retrogress toward renewed repression.

The Soviet Union cultivates 30 percent more acreage than the United States, including almost 12 times the potato acreage, 3 times the oil-bearing plant acreage, and over twice the wheat acreage. On the other hand, their cotton acreage is only a fifth of ours; their corn acreage, even after the new program, a quarter of ours. The Soviet Union has substantial numbers of livestock: two-thirds as many cattle and swine, four times as many sheep and goats, and about three times as many horses as in the United States. The labor input into agriculture is enormous, 47 million man-years annually, but with only a third being the work of able-bodied men aged 16-60. The comparable figure for the United States is 5.8 million. In contrast, Soviet agriculture is feebly mechanized, with only 15 percent of the tractor power, 11 percent of the trucking, and 12 percent of the electrical-power consumption of American agriculture. Mineral fertilizer inputs are perhaps 40 percent those the American.

Soviet agricultural output is extremely low, considering both the resources input and demand. It totals less than half the American, for a population at least 20 percent higher. True, in 1955 they grew

perhaps 75 million metric tons of potatoes, and 55 million metric tons of wheat, seven times and twice, respectively, the U. S. levels. But they produced only 3.4 million m.t. of raw sugar, compared to 4.1 million m.t. in the United States (inclusive of Hawaiian and Puerto Rican cane sugar). Vegetable-oil output, including that of small-scale mills, probably did not exceed 1.5 million m.t. in 1955, contrasted to 5.2 million for the United States, favored by higher-yielding plants--cotton-seed, flax, peanuts, and soy. Natural fiber output in 1955 approximated half the American level, and included about 1.3 million m.t. of cotton (excluding linter), 210,000 m.t. of wool, and 65-70,000 m.t. of linen. Soviet production of meat, lard, poultry, and eggs--the source of two-thirds the U.S. net farm income--was under 5 million m.t., a fifth of ours. Practically no apples, nor citrus fruits, and little tobacco were produced. In all, Soviet agriculture is not only low, but structurally primitive. The productivity of Soviet farm labor is 7 percent of ours; perhaps 13 percent our level, if able-bodied men alone are considered. In short, agricultural inefficiency is a major drag on the Soviet economy, with underinvestment creating losses rather than net savings in resources.

The Soviets have placed heavy and increasing effort upon the expansion of mining and refining. According to Soviet data, the share of the ferrous metallurgy, coal, petroleum, and building-materials industries alone rose, in the total increment of industrial fixed capital, from 21 percent in the period 1928-40, to 34 percent in 1940-55, and 35 percent in 1950-54. Official data also show that employment in the metallurgical, fuel-extraction, and building-materials industries grew, between 1937 and 1955, from 13.7 to 19.0 percent of free industrial employment (excluding cooperative members and collective farmers in industry), or from about 1.39 to 3.46 million persons. The output of the mining and refining industries, when weighted by U.S. 1937 prices, is estimated to have been 3.1 times as great in 1955 as in 1937, a tremendous increase.

In the United States, mining and refining, measured in the same prices and with a comparable coverage, are estimated to have grown 80 percent between 1937 and 1955. The ratio of American to Soviet mineral output thus declined, from 4.65 to about 2.7 to one, although the absolute American increase was 80 percent greater than the Soviet. But the relative cost of American expansion has been light indeed. The share of mining and primary metallurgy in expenditures for private productive facilities has dropped from 14.4 percent in 1935-39 to less than 7 percent in the 1950's. Employment in mining and

refining rose only from 2.0 to 2.1 million between 1937 and 1955. Thus the ratio of American to Soviet productivity per man-year rose from 3.1 to 4.5.

Why the cost of Soviet mineral-output expansion has been so high deserves comment. In several industries good efficiency has been achieved. In petroleum and natural gas, for example, the growth of Soviet production since 1950 has been almost half of ours (in absolute terms), with equipment inputs seemingly low and with a current productivity 42 percent the American. A good, well-paid, free labor force; access (during World War II) to new developments in geophysics, drilling, and pressure maintenance; and the concentration of effort on a few rich oil fields between the Volga and Urals contributed to these successes. Yet the share of petroleum and natural gas in the Soviet fuel balance fell to 23 percent in 1955, from 24 percent in 1937. (It was 65 percent of the U. S. fuel balance in 1953.) Moreover, the growth in output of the most inefficient fuels (lignite, peat, and oil shale), for which the input of labor (per unit of heat) runs 5-10 times higher, was 4.5-fold, 1937-55, compared to 2.5-fold for petroleum and natural gas.

These anomalies derive from the weakness of Soviet transportation and local distribution systems, from deficiences in cracking technology, and from reluctance to scrap existing investments in locomotives and stationary power plants equipped to handle only solid fuels. Thus, a pipeline from the Volga-Urals oil fields (Tuimazy, 54° 40'N 53°45'E) to the new refinery at Omsk (55°20'N 73°30'E) in Western Siberia was completed only in 1955. Further east, tank cars on an overloaded rail line provide the only transport, as they do in Central and North Russia. Furthermore, the Soviets have not been able to produce good-quality gasoline from high-sulfur, high-gum crudes like those in the Volga-Urals and Far Eastern fields. In consequence, much of the gasoline produced is substandard, with attendant effects upon engine performance and life. In addition, high-grade Caucasus crudes must be imported into the Volga area, while Volga-Urals residual fuel oil gluts the market. In natural gas, delays in developing local distribution, especially for household use, have led to pipeline utilization far below capacity and extensive destruction of natural gas by flaring. A Soviet petrochemical industry does not exist as yet. Dieselization has barely started on Soviet railroads. Thus, the general rigidity of Russia's capital structure has inhibited the adoption of more efficient technology and, with that, greater economy. This rigidity is, of course, a reflection of economic overcommitment.

In general, the Soviet Union has built up an economy that is basically nonrationalized. The stresses and strains of its operation have been limited in the past by direct controls made possible through the ultimate sanction of secret police terror. The decline of the secret police and forced labor since 1953 has brought about new and involuntary changes in the Soviet pattern. Most important was the decline of fuel supply in the Vorkuta fields of North Russia and in the Urals. Because of this, coal shipments from Western Siberia and Kazakhstan (where forced labor appears to have been relatively less important in recent years) to the Urals and European Russia soared, to over 30 million m.t. per year. Nevertheless, fuel and ore shortages in the Urals greatly reduced the rate of growth in pig iron output in that area, to 10.2 percent for 1954-55 combined, compared to 21.5 percent for the U.S.S.R. as a whole. Accelerated output by free labor in the Ukraine becomes necessary. Extremely high wage levels--50 percent and more above the Soviet average--and aggressive labor recruiting have given notable results: in 1956, the Ukrainian part of the Donets Basin alone produced 30 percent of all Soviet coal and 54 percent of the coking coal. But the effect of these measures upon the general labor market, especially in projects in remote and unpleasant areas, and upon overall consumer demand, may be great indeed.

IV. Soviet Resource Development: Problems and Prospects.

The Soviet Union has been able, over the past 30 years, to expand greatly its output of raw materials, especially minerals, timber products, fish, cotton, and sugar. But its record in the major foodstuffs--grain, meat, and lard, and in dairy products--has been poor. A structure of demand seriously distorted by military-economic considerations, piecemeal decisions, and harsh direct controls has led to very high real costs of raw-materials production. The frequent lack of economic incentives, especially in agriculture; an overriding emphasis on maximum immediate output as opposed to long-term efficiency; and an obsolescent technology have also raised real costs, in terms of capital and labor per unit of output. In general, inefficiency in raw-materials output has proven to be a major handicap in the Soviet quest for military-economic supremacy.

The fact is that the Soviet Union is not outrunning American growth. Between 1950 and 1955, Soviet pig iron output rose from 19 to 33 million m.t.; coal, from 185 to 276 million m.t.; cement, from 10.2 to 22.5 million m.t.; and primary copper, from about 190 to 290 thousand m.t. These gains compare favorably with U.S. figures for

the same period: a growth of 11.7 million m.t. in pig iron; a drop of 25 million m.t. in coal; a rise of 11.2 million m.t. in cement; and one of 74,000 m.t. in primary copper. But American gains in other minerals were far greater--76 million m.t. compared to 33 million, in petroleum; 640,000 m.t., compared to 320,000, in aluminum; 2.4 million m.t., compared to 238,000 m.t., in caustic soda, etc. Furthermore, the American economy has many productive branches virtually undeveloped in the U.S.S.R.--titanium paints, gypsum board, detergents, natural gas, etc. In addition, numerous indices (the steel to pig iron ratio, fuel consumption per kilowatt hour of energy produced, kilowatt-hours of power per kilowatt of capacity, metal cut per machine-tool bit, etc.) show a continued American advantage in the efficient use of resources, overcrowded housing excepted. These facts are also true, in greater or lesser degree, for other Western nations.

Soviet prospects for the future are dimmed by three major factors:

1. The great deficit of births in the decade 1940-50, which will permit very little increase in the labor force over the next 10 years, particularly if urbanization continues at its current rate. (City life, it should be noted, permits far less use of the labor of children and mothers than does peasant type agriculture.)

2. The revolutionary impact of nuclear warfare. While the Soviets can realize certain economies in direct manpower utilization and in steel, universal machine-tool capacity, and fertilizer basics by the shift from conventional to nuclear armaments, their defensive posture needs drastic improvement--or an abandonment of aggressive intentions. The Soviet Union, despite its enormous area, has only about 5 percent of the signal communications capacity of the United States, a weakness incompatible with effective air defense. Urban densities averaging 12,000 per square mile or more, with poor exits and local transport; the extreme concentration of railroad traffic; the lack of food and other supply margins--all these are vulnerabilities scarcely tolerable in the atomic age. Their rectification, let alone the vast outpourings of scarce resources and skills for active offense and defense, would require staggering investment.

3. Increasing unrest in the European satellites, beginning with the June 17, 1953, uprising in East Germany and culminating in the Hungarian revolt, has steadily lessened Soviet net tribute from these areas. Since the Soviet relies heavily upon Polish coal, zinc, and cadmium; East German uranium; Hungarian bauxite, and other Eastern European raw materials and manufactures, a worsening in its terms of trade and the possibility of complete denial further acerbate tensions within the Soviet economy.

Nevertheless, the Soviet Union retains an extremely dangerous capability for offensive military action, and for psychological and economic warfare. Its potentials for the future compare in extent with those of the United States and are adequate for an indefinite expansion, provided that the economy is rationalized and that its growth is paced rather than forced. The Ukraine and Caucasus, rather than the heartland between the Volga and Yenisey, represent Russia's optimum combination of accessibility, and of human and natural resources. It is in the Ukraine and North Caucasus and in the humid lands west of Moscow that the Soviet Union can solve, by adequate investment and the application of sound land management, its long-term problems of agricultural sufficiency. Widened international trade could further increase the efficiency of resource development, particularly if abetted by technological exchanges. But whether such transitions from today's policies can be effected within the Communist framework, and without upheaval, remains to be seen.

DR. CLEM: Dr. Shimkin is ready for questions.

QUESTION: Sir, I was much impressed with your recitation of the hydroelectric development of the Soviet Union. Would you tell us what proportion of the total power of the Union's potential the hydroelectric development represents?

DR. SHIMKIN: At the present time they get less than 14 percent of their output of electric power from hydroelectric sources. By 1960, however, it will probably exceed 17 percent. It is still very much smaller than in this country; but the direction, and particularly the location, of these sources are important. I want again to emphasize the question of industrial water supply, which is very short in European Russia.

QUESTION: You stressed the fact that the Soviets are emphasizing self-sufficiency in various zones. I was wondering if that included food; and, if so, to what degree they are successful, for example, in the area between the Volga and Lake Baykal.

DR. SHIMKIN: This is precisely the point that I tried to emphasize. The so-called "new lands" program, the 30 million hectares they have cultivated in the last few years, is intended to expand food output for the new mining and manufacturing areas in the deep interior. Central Asia is in a very deficient position from the standpoint of food production, because it has perforce specialized on cotton, and must import food and grain from western Siberia.

Irrigation in the southern part of the Ukraine and in the North Caucasus, which is now reasonably under way after many delays, will give a better balance to European Russia. But the Central and Northwest areas (Moscow and Leningrad) will have to import about two-thirds of their food supplies from the south.

The worst position is in the Far East.

QUESTION: Some years ago Mr. Molotov said that the Russian use of atomic energy was for peaceful purposes. They were going to use atomic explosions to divert the water from, I believe, one of the rivers in Siberia and make it go south. Has anything happened on that?

DR. SHIMKIN: No, sir.

I want, by the way, to mention one problem here. There has been a good deal of talk, about not only this aspect, but more substantively about Soviet power reactors. They have pretty ambitious programs in this regard. There is no doubt that in central Russia, particularly the Moscow region, and in Leningrad those would play an extremely sound economic role, for fuel there is very costly. The Moscow Lignite Basin is poor, and the planned 400 kilovolt line from the Volga projects is barely feasible economically. In addition to this, Leningrad has in recent years depended very heavily on Poland for its coal, and also on the Vorkuta labor-camp region, both of which have become undependable. Therefore the economic justification of a power program on atomic energy is maximum in central and northwest Russia.

Now, how much of this reactor program will in fact be for power and how much for military plutonium is anybody's guess. That they will expand I think is pretty certain. How economically and how safely from the standpoint of radioactive contamination and the like is anybody's guess.

QUESTION: Actually I had in mind this project to blow up--

DR. SHIMKIN: Oh, that is not an efficient way of using atomic explosives. And, secondly, this whole matter of river diversion is completely in the stage of fantasy.

QUESTION: You mentioned oil. Where do they actually produce this oil?

DR. SHIMKIN: This is a very good question. I have unfortunately not had enough time to develop that.

At the present time 60 percent of Soviet petroleum production, which totals around 70 million metric tons, is in the Volga-Urals basin, the so-called second Baku. Caucasus production is down from prewar to 14 million metric tons as opposed to 20 million. Their production in Central Asia has just about remained on a par; they have had some expansion in the Ukraine. In Western Siberia, although the geology is favorable, they have not had any real strikes. But last year they completed their first long pipeline from the Volga Basin, Tuimazy to Omsk, which is the site of a large new refinery. So petroleum products will become available more cheaply and reliably for Western Siberia and the new agricultural area. The Far Eastern position is very bad, both in terms of the slowness of petroleum output and in terms of the quality of petroleum.

Both in the Volga and in the Far East the Soviets have very heavy crudes, in the Volga Basin, with high sulfur also. Their technology is still inadequate to handle those economically, particularly for the lighter fractions. For this reason their national position is not as favorable as it appears from the gains in petroleum production since 1950. Finally, the distribution system is still very bad. According to their own figures of 1955, 95 percent of their petroleum was still being transported by railroad tank car, a very expensive way of handling it.

QUESTION: Would you care to comment upon materials from Communist China?

DR. SHIMKIN: The importance of Communist China is really limited to the Far Eastern area. The Far East to this day lacks adequate sources of iron ore. For example, the Komsomolsk Steel Mill still has to depend upon scrap from European Russia and upon pig iron from Manchuria.

In addition to this, China is in a position to supply moderate quantities of tin and tungsten from south China, although this production has still had very great difficulty from the standpoints of transportation and cost. In general, too, the Soviet Union must supply China with copper, and with petroleum products. So the net gain for the Soviet Union as a whole is relatively small, in contrast with the East European situation. For the Far East, however, the Chinese resources are exceedingly important.

QUESTION: Doctor, I wonder whether you could perhaps give me a little more information on the future natural resources of the satellites on which the Soviet Union is depending.

DR. SHIMKIN: I have indicated them very briefly, but I will stress them a little bit more.

In general, in mineral resources the Soviet Union is very heavily dependent upon uranium from Eastern Germany, to some extent from Hungary, and also from Bulgaria. Hungarian bauxite is of exceptional importance, representing around 40 percent of the total supply. This is going to be especially a problem in the future in view of the great shortage of copper in the whole Soviet bloc. The nonferrous metals position is the most crucial.

In addition to this, zinc is a major commodity, produced in Poland. Finally, the Poles have annually exported to Russia an average of 10 to 15 million tons of high-grade bituminous coal.

The main imports that they have had from Russia have been iron ore and copper. Approximately 75 percent of the iron ore consumed in the blast furnaces of the European satellites comes from the Soviet Union. All of these countries are very deficient in copper, as well as in chrome and nickel, which also must come from the Soviet Union.

So on a balance in terms of materials there is a two-way trade. However, the prices paid by the Soviet Union have been very favorable

to the U.S.S.R. In fact, the Eastern European satellites over the past decade have had a net export of around 10 percent of their gross national product in transfers to the Soviet account.

Now, whatever the consequences of Hungary might be, I believe that the Soviet Union will no longer be able to bleed the satellites in the way that it has in the past. It has to give more in exchange for what it gets. And this means that the whole picture is going to be transformed, particularly in regard to Soviet capacity to export capital, for example, to China and to the underdeveloped world. All of these capital exports that you have heard about in the last few years have not been Soviet exports. They have been satellite exports of capital.

Now, the question is, if the Soviet Union is no longer able to bleed the satellites to the same extent, will it be able to meet its commitments to these underdeveloped countries, and to China, as well as meeting the very serious internal problems that it has?

QUESTION: You have indicated some confidence in these Russian production figures. Do you feel that they are more reliable than they have been in the past?

DR. SHIMKIN: The question of Soviet statistics is a rather complicated one, but a subject on which there has been an immense amount of work done.

We, of course, have to be very skeptical about anything that is released from the Soviet Union. But we can adjust and rectify a great many of these statistics in several ways. First of all, we can do it through extremely thorough use of the public statistics for consistency, for context, and particularly for balances as shown by input-output studies. These kinds of measures can minimize the errors that are involved.

In addition to this, we have sufficient older literature in terms, for example, of climatic conditions, soil, mineral resources, and others, to get some limiting parameters. We also know a fair amount, not only from the literature but also from recent visits, to get an assessment of Soviet technology.

At the present time we feel that the overall volume of Soviet industrial production is known quite accurately. For individual commodities the errors can be very great. For example, we know now that

the figures on copper, lead, and zinc production that I published some years ago in my minerals volume were exaggerated by the inclusion of large amounts of secondary production, and that they overstate the primary metal production in these fields possibly by as much as 25 percent. These rectifications have to go on all the time. But I am very gratified to say that very few of our basic series have been seriously upset by the information that has come out in the past year.

Now, when I say all this, I am talking about margins of error in individual figures of at least 5 or 10 percent and in some of the smaller commodities as much as 20 or 30 percent. The importance, however, of the dimensions we are talking about is in relation to this country's output, rate of growth, productivity. I do believe that we know the Soviet measure of power to a very appreciable extent. The main difficulties we get into in this field are in comparisons not taking into account the differences in product-mix between this country and the Soviet Union, and comparisons that are done without enough care for definitions and content.

Let me illustrate one or two things. For example, in this country 65 percent of our agricultural output is in animal products. Therefore a comparison based purely on the relative output, say, of field crops, such as wheat and potatoes, tends to give very misleading results, especially when one ignores the extremely important production of citrus fruit and other aspects of a balanced agricultural output.

Again let us talk about coal production. You read about 390 million metric tons of Soviet coal production. Over 100 million metric tons of this production are not coal at all but lignite, and this must be adjusted for fuel equivalent.

Therefore you can run into extremely poor comparisons in hasty secondary sources. In addition to this, some of our most spectacular achievements have not been highly publicized. For example, as most of you are aware, the United States now is by far the world's largest producer of uranium. Our production is large enough so the the President was able to allocate 40,000 kilograms of uranium metal for the Atoms for Peace Program and for commercial development in this country. Now, 40,000 kilograms in terms of world production of a decade ago is absolutely an incredible amount. There is not the slightest question or doubt that our uranium production exceeds the Soviet's by many magnitudes.

Therefore, we must take this balance into account. We must not think only of steel output in the comparisons, but of such things as plastics, titanium production, and chemicals. When you take all of this into account, the comparisons I have made are brought into better focus.

DR. CLEM: Dr. Shimkin, we all want to thank you for coming down here again and talking to us.

(7 Feb 1957--3,750)B/ljt