JPRS 69867

27 September 1977

USSR

TRANSLATIONS ON USSR RESOURCES

No. 742

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ENERGY BASE OF THE PAVLODAR-EKIBASTUZ TERRITORIAL PRODUCTION COMPLEX

Moscow PRAVDA in Russian 3 Jul 77 p 2

[Article by M. Poltoranin and V. Sebast'yanov (Pavlodar-Moscow)]

[Text] Part 2. Lessons of the Complex*

The Pavlodar-Ekibastuz complex is one of the oldest in the East of the country. It grew up when the Sayanskiy and Bratskiy complexes were still on drawings and the South-Yakuktskiy giant did not even have a name. Here, on a narrow bridgehead, the interests of more than 20 ministries clashed for the first time and the consequences of the departmental problems became apparent. In other words, the Irtysh region industrial center gathered enough experience so that creators of similar future regions in the variety of natural resources, speed of development and shape of activity could extract certain lessons for themselves.

When enterprises of the complex were located in the Pavlodar Steppes, the very name implied a thorough study of the local raw materials. The Academy of Sciences of the republic, the institutes of the ministries should have prepared recipes for complete and efficient reprocessing of the mineral resources. Today, the basic features of the region could have been the proportionality of development, a close interrelation between production facilities and a universal reprocessing of industrial waste products. But during the entire existence of the complex, the Academy of Sciences of the Kazakh SSR hardly examined its problems. Two flagman ships of the republic, the scientific and the production, sail along different routes, on different seas. Nor did industrial institutes burden themselves with research work -- they took production technology from enterprises at other points in the country and "tied" it to Pavlodar. Some ministries, having obtained advantageous sites for construction,

* Conclusion. Start in PRAVDA of June 2.

proceeded to create enterprises on the shores of the Irtysh without taking into account the special features of local raw materials. The fate of the Pavlodar Aluminum Plant can serve as a characteristic example for the complex. It was erected on the basis of the Turganskoye bauxite deposit. After the enterprise was put in operation, it was found that the technology was not related to the nature of the raw materials. Geologists and specialists of the Ministry of Nonferrous Metallurgy did not study the quality of the bauxites thoroughly. As a result, the collective of the plant had to review the entire technology of production on the fly. This reflected negatively on capital investment yield. The efficiency of capital investments is also low at a number of other enterprises. The temporary visits of staff members of scientific research institutes in the last few months actually produced nothing. They just scratch the surface. What the complex needs is a systematic and extensive study of its problems. Specialists consider that for this a local network of industrial laboratories and regional branches of scientific research institutes is necessary. The course on developing large territorial-production centrifugal force in science from far away -- from the avenues of Moscow, Leningrad and Alma-Ata -- important problems of industrial regions sometimes look small on the background of the scale of the country. Only at the location, having seen how closely the problems are interrelated, can one recognize their importance to the national economy.

There is a great amount of work for research workers in the Pavlodar-Irtysh region. As before, valuable components from enterprises of nonferrous metallurgy and other industries are dumped into the lake. The problem of the raw materials base of the Yermakovskiy Plant of Ferrous Alloys is becoming more acute. In accordance with the directive of the 25th party congress, it must triple its capacity by the end of the five-year plan period and increase the smelting of ferrosilicon to a million tons per year. The quartzites are obtained by the enterprise from the Antonovskiy Deposit in Kemerovskaya Oblast, but already the Siberian miners are not in a condition to make regular deliveries. Yet, several kilometers from Yermak geologists discovered long ago the Zhuantobenskoye Deposit of quartzites with reserves of 200 to 250 million tons. These cheap local raw materials are not being utilized only because there is nobody in the scientific research institutes of the USSR Ministry of Ferrous Industry to study and propose a technology for their reprocessing. Or to take the production wastes of thermal electric power plants. When the Ekibastuz GRES are put in operation, the plants of the region will dump 140,000 tons of ash per day. With the local violent winds, the wastes threaten to turn into a calamity if they are not reprocessed immediately.

It is obvious that even the best recommendations of research workers will be useless when they do not encounter interested attitudes in the departments. Several years ago, for example, PRAVDA wrote about the interesting work of V. M. Ratinskiy, doctor of geological-mineralogical sciences, who arrived at an unexpected conclusion: the Ekibastuz coal contains a considerable percentage of alumina -- an aluminum intermediate product. A

technology was proposed for extracting the alumina from the raw fuel. In 1971, representatives of three ministries -- coal industry, nonferrous metallurgy and the USSR construction materials industry -- signed a document on building in the Ekibastuz an experimental combine for the comprehensive reprocessing of raw coal. From this raw material can also be obtained sulfur for manufacturing acid and mineral fertilizers. Regrettably, beyond signing the departmental document nothing further was done.

If one looks at the Irtysh region from the economic standpoint, many enterprises remind one of islands. They are tied together only by the water of at what was one time a desert river and by the electric lines of the Yermakovskaya GRES. This isolation was due to the fact that the complex was created without a well thought-out single program. The ministries think of the Irtysh region steppes only as a site for enterprises. In building plants, they frequently supply them with "their own" raw materials from far away, although this raw material is produced at Pavlodar in sufficient quantities, but by another ministry. Of course, this reflects on the yield of the complex. The oblast could produce today a time and a half more products at lower cost. After the first unsuccessful steps, sufficient time has elapsed to straighten the situation out and regroup in individual production sections. However, to combine the efforts of all ministries under a single head and orient them to final results is still impossible. Workers of the departments, as a rule, do not like to take upon themselves the initiative for drawing the various interests together, while local organs do not have the authority to do that. What is the outcome?

"The experience in creating our industrial center," stated B. V. Isayev, first secretary of the Pavlodarskiy obkom of the Kazakhstan party, "indicates that the territorial-production complex needs a single boss. It should be a coordinating center subordinated to the USSR Council of Ministers. It would bring the interests of departments within government control."

From the very start of organizing the complex, this organ could stop attempts of departments to chase after immediate results and would facilitate harmonious and proportional expansion of production. It must, moreover, have the authority to stop, when necessary, the financing of a facility, take away departmental money and transfer it to another section.

When the complex was born, before it started out on the main road, the oblast center of the Irtysh region had less than 40,000 inhabitants. Broad prospects were opened up ahead: besides tractor and aluminum plants, a petroleum refining plant and a roofing material plant were to be built. Therefore, the problem how and where to locate the enterprises were of great importance. To locate the plants on the outskirts of tiny Pavlodar would mean compressing it against the river, stunting its future growth. Putting the enterprises far into the steppes would provide space for expanding the city but would create problems of transporting people. Throwing away thoughts about consequences, leaders of the obkom and oblispolkom chose the first version.

This choice of immediate benefit costs the oblast center dearly now; it compressed the enterprises in too small an area. While 20,000 square meters of housing are being built in Pavlodar every year, the housing problem still remains acute. The city must grow only in height and still good buildings must be destroyed.

To provide enterprises and organizations fully with a working force, the cities of the region should have a population of about 450,000 persons. So far in Pavlodar, Yermak and Ekibastuz there live only 370,000 persons. Of course, the Pavlodar miscalculation cannot be blamed entirely for this disproportion -- it is due to several factors. One who has been in the Kazakh steppes at various times of the year knows how the summer sun burns and how the winter storms behave. The miserly earth does not spoil one with an abundance of greenery and each tree in the square is irrigated by the sweat of man. Working hands are expensive in the severe kray as nowhere else. Therefore, it is important to attract people with good living conditions. If there was an apartment with kindergartens, schools, stores and hospitals nearby, people would settle permanently there. These factors must be taken into consideration in building cities, especially in the East. Several ministries readily agree with this and promise to maintain strict proportions in financing. But they always allot a great deal of money for industrial construction, but cut corners for social-cultural facilities.

Local trends play an important role in creating the disproportions.

"Ministries give the money to the Kazakhstan Council of Ministers," stated Ye. G. Azarov, chairman of the Pavlodar gorispolkom, "for building municipal facilities in the region. Part of the money does not reach its destination."

A descending chain forms here. The cut-down money comes to the oblast center and the basic part of it is used for Pavlodar facilities. Other cities of the territorial complex get just the remains. If there were a coordinating center in the region, it would gather the departmental money in one hand and would distribute it as necessary. It would not allow bias in shaping cities and would make the ministries build the complex on the shores of Irtysh considerably better.

The directives of the 25th party congress stated: continue the development of the Pavlodar-Ekibastuz territorial-production complex. Behind this compressed line is work on a huge scale. The modern term "coefficient of efficiency of the complex" has been heard at the Pavlodar plants many times. So far, this coefficient is not very high here.

The first stage of developing the Pavlodar-Ekibastuz complex was completed. The second stage -- its improvement -- has come. The efficiency coefficient is now of the first priority. This is what life demands.

2291
CSO: 1822

OIL AND GAS WORKERS LIST ACCOMPLISHMENTS

Moscow AGITATOR in Russian No 16, Aug 77 pp 9-11

[Article: "The Rates Are Increasing"]

[Text] For the All-Union Day of Workers in the Oil and Gas Industry -- 4 September

The labor successes of the extractors of oil and gas contribute greatly to a sharp rise in the effectiveness of all public production. Increasing more and more is the role of oil and gas as a raw material for producing valuable chemical products, and the toilers of the oil and gas industry are giving more and more of it to the homeland. Thus, during the first year of the Tenth Five-Year Plan our oil flow increased by almost 30 million tons, and the gas flow increased by 32 billion cubic meters.

The history of domestic oil extraction is over 100 years old. The brightest, most fruitful of these years are those for which the counting began with the Great October Revolution. Following its victory V.I. Lenin set forth the task of restoring the oil industry and developing it at an accelerated rate. "Dear comrades!" he wrote to the Baku workers, "I have just heard a brief report... on the situation of Azneft' [Azerbaydzhan Oil Industry Trust]. There are many difficulties in this situation. Sending you my warm greetings, I ask you to hold out in every way for the near future. The beginning is especially difficult for us. It will be easier later. We should and will attain our victories at any cost."

The year 1918. The main oil fields of Baku, Groznyy, and Maykop were almost completely destroyed. Extraction of oil fell from 10.8 million tons in 1916 to 4 million tons; in 1920 the young Republic of Soviets did not even get this. But even at that time, in a most difficult period, Soviet specialists and oil men were solving problems of rational development of oil deposits, of maximum extraction of it from the depths of the earth, they were beginning to search for new stores of it. The emergency measures taken by the party and the government for restoration of the oil fields

made it possible 10 years after the October Revolution to surpass the prerevolutionary level of oil extraction.

The oil workers completed the first five-year plan in 2.5 years and in 1932 extracted over 21 million tons -- almost two-fold more than the highest indicator of czarist Russia, 11.3 million tons (1910).

The country received the second 10 million ton addition to the extraction of oil in 1940. Created by this time in the Uralo-Volzhskiy Rayon was a mighty oil base for the country, a "second Baku," where now there are over 400 oil and 50 gas deposits.

Large regions of oil extraction were created during the years of Soviet rule also in Kazakhstan, Central Asia, Belorussia, the Ukraine, the Komi ASSR and other regions of the country. The center of the oil industry has now been transferred to Western Siberia, accelerated development of the oil and gas riches of which began in the second half of the 60's. This region, despite the very difficult natural and climatic conditions, is being developed at high rates. This is the result of scientific and technical progress in the sector, one of the deciding factors of which is complex automation of production processes in oil extraction and industrialization of laying out the fields on the basis of complete automated installations.

Fully automated oil fields produce more than two-thirds of all the oil. Already operating are 25 automated systems of control of technological processes, making it possible effectively to control the fund of wells and to incorporate the best technological processes using electronic computers.

In the first year of the Tenth Five-Year Plan in the USSR 520 million tons of oil together with gas condensate was produced. This is 120 million tons more than in the United States of America. Let us recall that czarist Russia lagged behind the United States three-fold regarding extraction of oil. From 1913 through 1976 the United States increased the extraction of oil approximately 12-fold, but the USSR increased it 50-fold!

Soviet oil men should give the homeland 550 million tons of oil and gas condensate in the year of the 60th anniversary of the Great October Revolution -- 62.5 times more than 60 years ago. Just the annual increase in extraction will be almost equal to all the "black gold" extracted from the depths of the country in 1940.

Tbe workers of the sector, having unfolded a labor competition in honor of the 60th anniversary of the Great October Revolution, are striving to surmount the outlined high barrier ahead of schedule, and they are attaining excellent results. Extracted above the plan even in half a year was 700,000 tons of oil. The drillers sunk about 150,000 meters of wells above the plan.

The highest award of the homeland, the Order of Lenin, was awarded to 10 front-ranking collectives for successes in development of the sector. Among

Extraction of Oil (Together With Gas Condensate)

	Millions of Tons
1918-1940 (23 years)	364
1946-1955 (10 years)	421
1977 (1 year)	550

them are Glavtyumenneftegaz [Main Tyumen' Administration for Oil and Gas], and the production associations Tatneft' imeni V.D. Shashin, Bashneft', Grozneft' and Azneft'.

In the vanguard of the competitors are the collectives of Glavtyumenneftegaz, and the associations Komineft', Tatneft', Bashneft', and Kuybyshevneft'. Constantly high labor indicators are attained by the drilling brigades headed by Heros of Socialist Labor, foremen A.D. Shakshin, G.K. Petrov, G.M. Levin, M.I. Sergeyev (Tyumenskaya Oblast), G.M. Khadiyev (Tatariya), T.M. Vil'danov (Bashkiria), M.M. Gambarov (Caspian), and the brigades of tower assemblers, headed by Heros of Socialist Labor K.G. Ikhin (Bashkiria), G.M. Bagmanov (Tataria), A.G. Timchenko (Western Siberia), and the repair brigades of foremen A.G. Abdullin from Tatneft', A.G. Basyrov from Bashneft', and A.S. Prokayev from Orenburgneft'. Working excellently are the drillers of foreman D.M. Nurutdinov (Tataria) -- the initiators of a competition for accelerating the putting of new wells into operation. This initiative has been taken up in all oil extracting regions of the country.

In essence, there was no gas industry in czarist Russia. Extracted was only a little of the so-called casing-head petroleum gas at Baku and Groznyy oil fields. In St. Petersburg, Moscow and elsewhere small plants for artificial gas still operated. The total production of gas in 1913 came to 17 million cubic meters in all. Establishment of the gas industry was started after the Great October Revolution.

Extraction of Gas	(billions of cubic meters)
1928-1940 (13 years)	20
1946-1960 (15 Years)	201
1977 (1 year)	342 (plan)

Extraction of gas in the country started to grow beginning with 1920 and in 20 years exceeded 3 billion cubic meters. The invasion of the fascist aggressors caused great damage to the gas industry, but even in 1945 the

extraction of the "blue fuel" exceeded the prewar level and during the following decade reached 9 billion cubic meters per year.

The USSR's gas industry became an independent sector of the national economy in 1956 and, developing at accelerated rates, turned into a large highly effective sector of the socialist economy.

During the first year of the Tenth Five-Year Plan over 320 billion cubic meters of gas was extracted in the USSR. Just the annual increase in its extraction came to 32 billion cubic meters. Whereas a little more than 60 years ago our country lagged behind the United States 100-fold in the extraction of gas, now this gap has been reduced to 1.8-fold. During the last 20 years the United States increased the extraction of gas approximately two-fold, but the USSR increased it almost 27-fold.

It was possible to attain such unprecedented rates of the gas industry thanks to accelerated development of large deposits in new gas-bearing regions -- Western Siberia, Turkmenia, and the Orenburg region, which are yielding almost one-half of the union-wide extraction.

Built and operating are high-capacity gas transport systems: the Central, Ukraine, Volga region, Ural, Central Asia--Center, northern regions of Tyumenskaya Oblast--Ural--Volga--Center, Medvezh'ye--Punga--Vuktyl--Ukhta--Torzhok--Minsk--Ivatsevichi--Dolina--Gosgranitsa and others. The total extent of trunk gas pipe lines has exceeded 105,000 kilometers. Basically formed and continuing to be improved is the Unified System of Gas Supply of the USSR, which is carrying out the uninterrupted technological process of supplying gas to the consumers. The greatest growth in its consumption during the past five-year plan was attained in the chemical industry, amounting to 3.3-fold, and in ferrous metallurgy, machine building and metal working approximately two-fold. Now produced with the use of gas is 85 percent of the pig iron, 87 percent of the steel, 44 percent of the rolled metal, 61 percent of the cement, and about 90 percent of the mineral fertilizers. The use of gas makes it possible better to utilize the capacities of enterprises, to lower outlays for manufacturing output, and to increase labor productivity and improve the quality of products. About 166 million inhabitants of our country use gas in everyday living.

Created and being developed successfully owing to complex processing of gas is a new gas-chemical subsector for production of gas condensate and elementary sulfur -- a high-quality raw material for chemistry and petrochemistry. The largest enterprise of this subsector is the Orenburg complex, where 30 billion cubic meters of sulfurous natural gas is extracted and processed, and produced in a year is over 700,000 tons of sulfur, and about 1.8 million tons of stable gas condensate. With the putting of a third phase into operation the total capacity of the complex will reach the planned mark -- 45 billion cubic meters of gas per year.

In its depths Western Siberia stores almost three-fourths of the union-wide prospected reserves of natural gas. Their development has decisive significance

Growth in Production of Output of the Chemical and Petrochemical Industry (1913 = 1)

1913	1
1940	17.5
1950	34
1960	134
1965	262
1970	468
1975	772
1980	1258

for development of the gas industry not only in the Tenth Five-Year Plan, but also in subsequent years. The largest gas extracting complex continues to be formed here. High capacity automated enterprises are already operating under the conditions of tundra, swamps and permafrost of the Siberian north. Last year Western Siberia yielded 44 billion cubic meters of natural gas. Now on its fields it is anticipated to obtain 66 billion cubic meters, which will allow the region to take first place in the country with respect to natural gas extraction. At the end of the five-year plan Western Siberia will reach a general level of extraction of 155 billion cubic meters. In order graphically to "feel" the weight of this figure, let us recall that it is almost equal to the volume of gas extracted at all fields of the country 10 years ago.

It is foreseen to extract 342 billion cubic meters of "blue fuel" in the year of the anniversary of the Great October Revolution. The letter of greeting from comrade L.I. Brezhnev to the collective of the Orenburg-gazprom Association, in which a high evaluation of the work of the sector is given, has been welcomed with vast enthusiasm by the country's gas workers and they have unfolded an active search for still unused reserves. They have pledged to fulfill ahead of schedule the plan for the jubilee year, the year of adoption of the new Constitution of the USSR, to extract above the plan and the additional assignment more than 3 billion cubic meters of gas, and to provide not less than 90 percent of the growth in production owing to a rise in labor productivity.

The results of the first half-year are a reliable beginning for successful fulfillment of high obligations. The half-year plan for extraction of gas was completed early, on 27 June. In relation to the corresponding period of last year the increase in extraction came to 12.6 billion cubic meters. The country received above the established assignment 2.8 billion cubic meters of gas, more than 27,000 tons of gas condensate, and 8,000 tons of elementary sulfur. The rate of growth of production came to 9.3 percent against the plan of 6.6 percent. The whole increase in output was provided owing to growth in labor productivity, which was increased by 9.5 percent against an assignment of 7.4 percent.

At the head of the competition in honor of the 60th anniversary of October are the gas extractors of the Orenburg region, Turkmenia, the Ukraine, and Komi. Being disseminated widely is the experience of the foremost brigades and services, whose tireless creative search is making a worthy contribution to development of the sector. Among them are the drilling brigade of Honored Foreman V.A. Linichenko from Turkmenia, the brigade for capital repairs of wells of Honored Foreman A.G. Torby from Maykop, A.N. Vasil'yev's brigade of tower assemblers, and the collective of operations-production service No. 9 from the Orenburg region.

Widely known today are the names of V.N. Doroshenko, operator for extraction of gas, and winner of the State Prize of the Ukrainian SSR (Shebelinskiy gas field administration), V.M. Mikhaylov, operator for extraction of gas (Nadymgazprom Association), V.G. Maslyayev, gas electrowelder (Mostransgaz Association), V.A. Sergeyev, machine operator of the Sredaztransgaz Association), S.V. Tatarenkov, fitter for repair and servicing of technological installations (Uraltransgaz Association). Equal to these and other innovators of production are thousands of gas workers, competing for a worthy greeting to the 60th anniversary of the Great October Revolution.

10908
CSO: 1822

PROSPECTS FOR MINING AND USE OF COAL RESOURCES

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 8, Aug 77 pp 91-98

[Article by A. Krichko, doctor of engineering sciences, L. Semenov]

[Text] The national economy of the USSR is solving successfully the problem of advanced development of the fuel-power industries by efficient utilization of chemical fuel resources, nuclear power and other renewable sources of energy.

The coal industry holds first place in the country on the scale of developing power resources. In 1975, the mining of coal exceeded 700 million tons. We will note for comparison that the next in volume of production, the petroleum industry, produced in the same year, 491 million tons (including gas condensate).

Directives of the 25th party congress established the directions of improving the structure of the fuel-power balance: efficient combination of various types of fuel, wide use, along with nuclear power, petroleum and natural gas, of coal and bituminous shale, and greater use of secondary power resources. It is planned to increase coal production in the Soviet Union in 1980 to 790-810 million tons. The prospects of developing coal mining are considerably greater than the possibilities of increasing the production of other mineral fuels. At the modern stage of exploration of resources, it is technically possible to triple the annual production of coal in the country to 2.2 billion tons. Of these the greatest part can be mined in eastern basins.*

Scientific-engineering achievements and geographic shifts in the disposition of production forces open up new possibilities for improving the economics of mining and raising the efficiency of utilization of coal in the national economy.

* See Handbook "Development of the Fuel Industry." Moscow NEDRA, 1975 p 126.

Nuclear Power and Chemical Fuel

Of all the countries in the world that are the largest consumers of energy resources, the USSR has the most efficient, optimally shaped fuel-power balance. The raw materials-fuel base of the national economy is also developing systematically, taking into account the maximum efficiency of social labor. The ratio of the most efficient types of chemical fuels -- petroleum; natural gas; coal and shales by strip mining -- makes up about 3/4 of the production of combustible minerals.

The economic development of the USSR is based fully on its own fuel-power resources. The change in the structure of the fuel balance, achieved in accordance with plans, as the explored reserves of high quality combustible minerals such as petroleum and natural gas increase, will approach, in the current five-year plan period maximum values (in ratio of the balance). The increase in petroleum and gas consumption in the USSR is determined not by temporary, business advantage of their utilization compared to coal, as in the developed capitalist countries, but by the national economic efficiency and social-economic advantages of their use in a number of industries taking into account their long-term prospects.

Planning organs plan to provide, on a priority basis, the natural gas and petroleum requirements of all industries in which they are used as raw materials or fuel with the greatest total power and chemical efficiency and where their use will lead to improving the quality of the product and maximum efficiency of social labor. These include municipal and domestic services (over 165 million persons already use gas in their homes), the chemical industry, metallurgy, cement production, etc. Only after satisfying the needs of the population and of technological consumers can gas, for example, be used in power production.

In the capitalist world, the fact that power monopolies are trying to obtain maximum profits in the shortest time by exploiting these or other resources leads to great losses of social labor. Thus, in the United States, in spite of the increasing scarcity in its fuel balance, natural gas is frequently used inefficiently. Here is a characteristic statement by American specialists: "Due to a lack of local natural gas, especially in the Los Angeles region, installations for the gasification of coal will be built. However, one cannot fail to call attention to the fact that in the Los Angeles region, 75 percent of the electric power is produced by burning natural gas. Burning coal to produce electric power and not converting it to gas and then burning this gas would be more efficient and cheaper for the consumer and would free a great amount of gas for domestic use.*

* W. W. Reynolds and H. S. Klein. Petrochemicals and Energy in Perspective. "Chemical Engineering Progress," 1975, Vol. 71, No 3, p 16.

Over 4/5 of the total electric power in our country is produced at present at thermal electric power plants -- using coal for about half of it and fuel oil and gas, taken together, for the other half. New, powerful thermal electric power plants are being built primarily for using coal. Some 500,000 and 800,000 kw power units were put in operation and construction began of the largest coal GRES in the world with rated capacities of 3.6 to 6.4 million kw (Permskaya, Ekibastuzskaya, Berezovskaya No 1, etc).

A promising trend in developing the fuel-power base is the wide utilization of nuclear power. In accordance with the directives of the 25th party congress, large nuclear electric power plants (AES) are being built in the European part of the country along with thermal plants. As is well-known, in regions remote from resources of cheap chemical fuel, the cost of production at modern powerful AES is somewhat lower than at thermal plants. Therefore, in spite of the high cost of equipment for the AES, their overall economic indicators under such conditions are better than those of thermal electric power plants.

In the opinion of the majority of scientists, the main problems the solution of which will signify the start of a new stage in the development of nuclear power, are the improvement and wide utilization of reactors with fast neutrons. A 600,000kw BN-600 reactor is now being built in the Urals. Reactors of this type will make it possible to utilize nuclear power resources 20 to 30 times more fully by producing plutonium than reactors with thermal neutrons. However, existing experimental-industrial reactors with fast neutrons take an excessively long time to double the fuel -- 15 to 20 and more years.

Academician A. P. Aleksandrov, president of the USSR Academy of Sciences, thinks that for the rate of growth of nuclear power of 100 percent in 10 years, the time for doubling the amount of plutonium should be not greater than 8 years. This follows from the necessity of a gradual reduction in the requirements of natural uranium by expanding the use of plutonium in reactors with thermal neutrons, in connection with the unavoidable increase in cost of thenatural uranium. "Investigations show," -- writes A. P. Aleksandrov, "that to increase the production of plutonium in fast neutron reactors, it is necessary to raise the heat intensity in the active zone, reduce the amount of the moderator or improve its nucleo-physical properties, reduce the amount of fuel in the overall fuel cycle, accelerate the radio-chemical and mechanical regeneration of fuel and raise the density of the substance fissioned in the active zone. The solutions to these problems is possible and modern planning developments provide the necessary progress; however, these are difficult problems and their practical solution will be obtained in 10 to 15 years."*

* VESTNIK AKADEMIINAUK SSSR, 1975, No 2, p 29.

In the very near future, the installed capacity of thermal electric power plants in the country will reach the gigantic level of 200 million kw. Since coal is their main fuel base, efforts of scientists and practical men must be directed, first of all, to reducing the cost of this kind of fuel and raising the efficiency of its utilization. A reduction in the unit consumption of fuel for released electric power from 340 to 325-328 grams/kw-hr from 1975 to 1980 will save 38 to 40 million tons of conventional fuel.

Engineering progress in thermal power engineering will be based, as before, on utilizing high pressure and high temperature water steam, increasing the capacities of the power units and introducing automation. The first 1.2 million kw power unit was manufactured; a prototype of a boiler unit with a productivity of 2650 tons of steam per hour, and using coal as fuel, is being made.

The use of coal in magnetohydrodynamic [MGD] electric power plants may become an efficient trend in engineering progress. As is well known, the efficiency of modern steam turbine electric power plants is limited to 40-42 percent. At the same time, the efficiency of the magnetohydrodynamic cycle of conversion of the chemical energy of the fuel into electrical energy is up to 60 percent. The utilization of coal containing in its ash ionizing mineral components will make it possible in the future to eliminate the addition of certain metal compounds to low temperature plasma, which is necessary when burning natural gas. The High Temperatures Institute of the USSR Academy of Sciences has a U-25 experimental-industrial installation which operated for over 4000 hours. The available experience made it possible to proceed with the design of large units. Practical problems are being solved in creating MGD-generators with a capacity of about 1 million kw.

The basic trends in the development of the USSR national economy in 1976-1980 provide for locating new thermal electric power plants, first of all, in regions where coal deposits can be strip mined most efficiently. Of the explored reserves of such coal, 99 percent are in eastern regions. In the European part of the country (including the Urals), industrial reserves of coal, suitable for strip mining, are less than 1 percent of the total in the country. As a whole, potential coal reserves are located extremely irregularly. Table 1 shows data on the location of coal reserves in the economic zones of the USSR.

Consequently, of 5730 billion tons of conditional coals, 5558 billion tons, or 97 percent are located in the eastern regions of the country: in the Kazakh SSR, Western and Eastern Siberia, in the Far East and in the republics of Central Asia.* Here are created electricity and power consuming production facilities, the output of which (aluminum, ferrous alloys, synthetic rubber, chemical fibers, etc.), it is economically efficient to transport over practically any distance. It is less economical

* In Handbook "Optimization of Development and Location of the Coal Mining Industry." Novosibirsk, NAUKA, 1975.

to transmit power over ultra-long electric power transmission lines due to its high losses. However, this method also, as shown by calculations, is feasible at 1150kv AC and 1500kv DC and, especially, when in the future electronic transmission of power over new superhigh conductivity cable installations is achieved. This is being developed by scientists of the Power Engineering Institute imeni G. M. Krzhizhanovskiy. The creation of ultra-long electric power transmission lines will make it possible to solve one of the key problems of power engineering posed by the 25th party congress: connect to the consolidated power system of the European part of the country the power systems of Kazakhstan, Central Asia and Siberia. It will become possible to maneuver the capacities of electric power plants widely in connection with the difference in time and the noncoincidences in the load schedules in various power systems.

Table 1
(in %)

(1) Экономическая зона	(2) Запасы			
	(3) кондиционные	(4) балансовые категорий $A+B+C_1+C_2$	(5) категорий $A+B+C_1$	(6) углей, пригодных для коксования
(7) Европейская часть РСФСР	2,8	19,7	22,6	33,2
(8) Урал	0,2	1,1	1,4	0,6
(9) Восточные районы РСФСР	94,0	70,3	64,0	58,4
(10) Казахстан	1,9	7,3	10,0	6,8
(11) Республики Средней Азии	1,1	1,6	2,0	1,0

Key: 1 -- Economic zone; 2 -- Reserves; 3 -- conditional; 4 -- balance categories; 5 -- categories; 6 -- coal suitable for coking; 7 -- European part of the RSFSR; 8 -- Urals; 9 -- Eastern regions of the RSFSR; 10 -- Kazakhstan; 11 -- Republics of Central Asia.

An important trend in assimilating the highly efficient coal resources of the eastern regions is utilizing coal of a number of basins and the products of their reprocessing in regions of the European part of the country (including the Urals) where fuel is scarce.

The growth rate of production forces depends to a considerable extent on increasing the scale of coal utilization and other fuel-power resources, establishing proper proportions of the development of coal mining in each region of the country, since unit reduced costs in the basins vary up to 8-10 times. The coal industry in the USSR, unlike in capitalist countries,

was always given great attention. Thus, even in the years of the most intensive development of the petroleum and gas industry party and government decrees were issued on developing a number of basins, and timely measures were taken on increasing the production of coal fuel. The increase in coal mining exceeded 160 million tons in the last 15 years.

The decree issued in 1976 by the CC CPSU and the USSR Council of Ministers "On measures for the development of the coal industry of the Donetsk Basin in 1976-1980" specifies increasing the capacity of coal mining in the basin during the indicated period by 28 million tons by putting in operation new mines and modernizing existing ones, and begin construction and modernization of mines with an overall capacity of 18 million tons per year. It was acknowledged to be necessary to designate a number of mines and enriching factories under construction as the most important national economy construction sites, and build new coal machine building plants and modernize existing ones. Coal mining in the basin must be increased to 245-250 million tons in 1985. The problem of increasing, first of all, the mining of coking coals and anthracites is being solved.

However, the possibilities of the oldest basin in the country are not unlimited. Mining is done here basically in deep shafts (700 to 1400 meters) and over 40 scientific research, planning-design and other organizations are working on the complex problem of raising the efficiency of mining deep seams.

A considerable part of the requirements for fuel for electric power plants and industrial enterprises in the Urals, the Volga region and even of the Center is provided by imported Ekibastuz and Kuznetsk coals. According to our calculations, reduced costs (per ton of conventional fuel) using these coals in the Urals costs, on the average, only half as much as operating on local Chelyabinsk and Kizelovsk coals. Especially promising is an increase in the use of Ekibastuz coals, since the capital investments for the development of mining them are several times less than those for the Urals coals. As noted in A. N. Kosygin's report at the 25th party congress, it is planned in the current five-year plan period to expand the use of the Ekibastuz and Kansko-Achinsk coals for the production of electric power and change over a number of large thermal electric power plants in the Urals and the Volga Region to using coal instead of fuel oil. By 1980, the capacities of coal mining in Ekibastuz will increase to 72 million tons.

The basic amount of the most expensive fuel is produced in regions where there is a scarcity of power resources; for example, lignites are mined in the Moscow Basin by the underground mining method. The possibility of replacing them with imported coal from the eastern basins (as well as by more transportable products of coal reprocessing) is confirmed not only by calculated savings of reduced costs, but also by the cost relationships obtained by the consumers on the basis of existing fuel prices and transportation rates. Thus, according to the data of the Kashirskaya GRES,

which was changed over in recent years to using Kuznetsk coal produced by strip mining, the coal cost the plant 20.15 rubles per ton of conventional fuel instead of 21.17 rubles for local Moscow Region coal.

If the Kuznetsk coal and concentrate, which are very transportable (due to the low ash content and a high calorific value), are used more widely in the European part of the country (including the Urals), it will be possible to expand the zone of consumption of the coals of the Kansko-Achinsk Basin which are the cheapest in the country. It could become the basic power base of Western Siberia, including the Kuzbass. According to our calculations, this will lead to a considerable saving in the national economy. Although when transporting the Kansko-Achinsk coal to the industrial centers of Western Siberia, the reduced costs increase by 2 to 4 times due to transportation costs, each ton of conventional fuel when used in Western Siberia, will cost 25 to 30 percent less than local coal. It is also obvious that to meet the demands of electric power users in this region (where there are no large consumers of heat), it is expedient to transmit power electrically from the thermal electric power plants at the Kansko-Achinsk Basin deposits.

Production of Coke and Quality of Metal

In connection with the efficiency of utilizing Kuznets coal to produce power in a number of regions and at the center of the country, and the growth of metallurgy in the South and the Center of the country, the problem arises of broad development of interbasin transportation of coal concentrate for the coke-chemical industry. The following premises exist for this. First, the actual and the future production costs of the coke concentrate at the Kuzbass are the lowest in the country and are 1.5 to 2 times lower than at the Donbass.* At the same time, the low ash content for coking is the most transportable coal fuel.

There is no question that it is not always expedient to increase the volume and distance of transporting raw materials, in spite of obtained savings in the production of one or another product. However, taking into account all factors, the problems of developing interbasin transportation of sintering coals must, in our opinion, be solved in the current five-year plan period.

The situation is not only in that utilizing Kuznetsk concentrate at enterprises of the European part of the country makes it possible to reduce operational costs and capital investments for producing metallurgical fuel. Although it is most efficient to obtain coke for Kuznetsk coal alone (the reduced costs per ton of coke will, in this case, be lower by several rubles), practically it is more expedient to prepare complex mixes for coking using Donetsk and Pechora coals.

* The basis of the difference is in the unit capital investments and labor-intensiveness of mining the coal due to mining factors, and higher ratio of strip mining of Kuznetsk coal. In 1975, the productivity of labor of the shifts in Kuzbass was 2.2 times higher in the Donbass and this difference will increase in the future.

One of the most efficient ways for expanding the utilization of the abundant sintering in coke mixtures may be a mixture composition taking into account the qualitative (petrographic) features of the coals of the three basins. Since the mixtures of the coke-chemical plants of the South and Center contain up to 15 percent of inert components (while at the enterprises of the Urals and Siberia -- 30 percent), it appears possible to utilize in them a considerable amount of Kuznetsk poorly-sintering coal. In most cases, brand SS coals have a low ash content and, what is especially important, they have a low sulfur content. These coals make up a considerable amount of the Kuzbass reserves suitable for assimilation in the very near future. A great part of their explored reserves so far, however, is not planned to be used in charges of the Eastern plants due to a high content in them of inert components; they are used for power production.*

In the very near future, strip mining of low-sintering coal will reach 40 million tons. Preparing blends for coking by assimilated methods and using the cheap coals of the Kuzbass as additives to Donetsk and Pechora, the blends become valuable coke-chemical raw materials. The coke gas and chemical products obtained as byproducts reduce the consumption of more expensive local fuel in the European part of the country.

The USSR is in first place in the world in the production of cast iron and steel. The coke-chemical industry is faced with great problems for providing the level of development of metallurgy as directed by the 25th party congress.

The improvement of the quality of blast furnace coke remains one of the most important problems. Metallurgical plants of the East and the Center use coke with an 0.5 to 0.6 percent of sulfur content, while the enterprises of the South use coke with 1.7 to 1.8 percent sulfur content. Academician I. Nekrasov of the Ukrainian SSR Academy of Sciences thinks that a reduction in the sulfur content of blast furnace coke is a must condition for producing high quality cast iron at the southern metallurgical plants of the country.

In this connection, very significant is the experience of the Novolipetskiy Metallurgical plant which assimilated the production of low sulfur content coke from a mixture of Donetsk, Pechora and the abundant Kuznets concentrates. The sulfur content of coke produced at two powerful coke batteries decreased by almost 3 times to 0.6 percent; its mechanical strength remained at a high level and the production cost decreased. The reduction in the sulfur

* I. V. Yeremin. "Analysis of Raw Materials Coal Resources of the Coke-Chemical Industry on the Basis of Industrial-Genetic classifications IG and RGI . TRANSACTIONS OF THE FOSSIL FUELS INSTITUTE, Issue 1, Vol. 27.

content of the coke facilitated its lower consumption in smelting cast iron and raised the productivity of the blast furnaces. The excellent quality indicators of the produced cast iron made it possible to use continuous casting installations in the production of converter steel. The low sulfur content, high strength coke from the coal of the three basins produced by this plant has the government emblem of quality.

Eastern and Ukrainian coal-chemical institutes carried out studies on obtaining low sulfur content coke from a blend using Kuznetsk coal for the 5035m^3 Krivoy Rog blast furnace, the largest in the world. The possibility was established of supplying, in the current five-year plan period, to the Kirvoy Rog and plants in the Ukraine about 4 million tons of Kuznetsk concentrate per year, mainly from lean sintering coals. In this connection, it is expedient to accelerate the construction on enriching factories in the Kuzbass. The problem of increasing the utilization in blends of low-sintering and gas coal and producing coke that meets modern requirements of metallurgical production is beyond the framework of the more efficient realization of Kuzbass resources. No less important is its solution for the Donetsk Basin where these coals make up the basic part of the balance and forecast reserves. Very promising is the wide introduction of the new technology for preparing blends and new processes of coking, including the continuous process.

Positive results were obtained at an industrial pilot installation of the Zapadno-Sibirskiy Metallurgical Plant in which a process was assimilated of deep drying and heating of the blend in a fluidized bed. When coking a blend heated to 150°C, the productivity of the coking ovens increases by 40 to 45 percent, the consumption of heat for the process and the time of coking are reduced by 15 percent, and the coke quality is improved. At the same time, this method makes it possible to increase the use of low-sintering coals, especially those produced by strip mining and considered so far as power coals brand SS and of technological group G_6 (along with G_{17} and K_2). In 1975, the Zapadno-Sibirskiy Plant put in operation the first coking battery in the USSR with a capacity of 1 million tons with ovens 7 meters high and a volume of 41.6m^3. After the construction of the department of thermal preparation of blends, the productivity of the battery will increase to 1.5 million tons annually.

It was established by experimental coking at the Donetsk Coke-Chemical Plant that with preliminary thermal preparation, the content of gas coals in the blend may reach 60 percent. In the Donbass, the reserves of gas coals exceed by more than 5 times the reserves of coking coals and by 3 times -- the reserves of rich coals. The mining of gas coals requires considerably less capital expenditures. In the country as a whole, in the very near future, it will be necessary to mine up to 200 million tons of bank coal annually. Therefore, it is important not to relax attention to research and development for expanding the raw materials base of the coke-chemical industry.

There are available in ferrous metallurgy production capacities designed for 25 to 30 years of operation and the putting in operation of new ones make it possible to conclude that in the period up to 2000 the blast furnace process will remain the basic method for producing the primary metal.* According to our calculations, requirements in rich coal coke will increase during that period almost directly proportionally to the increase in the scale of production of cast iron. This is due to the fact that, in spite of the reduction in the unit consumption of fuel in the blast furnace process, coke and breeze coke will be used in a number of other productions such as agglomeration, ferrous alloys, electrode, as well as in nonferrous metallurgy and for producing phosphorus, sodium carbonate and several other chemical products. It is possible that on the border between the 20th and 21st centuries, a changeover to a new technology will begin -- direct reduction of metals from ores by gases produced as a result of pyrolysis of coal and water by the heat of the high temperature of nuclear reactors.

Problem of Producing Artificial Liquid Fuel

Besides the Kuzbass and the Donbass, there are developing in the country two more fuel bases of all-union importance, the potential possibilities of which in the future are determined by the volume of mining of fossil fuel counted not in tens of millions, but in hundreds of millions of tons of conventional fuel per year. These are the West-Siberian petroleum-gas and the Kansko-Achinskiy coal basins. Their advantages are the possibility of reducing the cost per ton of conventional fuel to a minimum due to the considerable reserves of the deposits. At the same time, there is an essential difference in the conditions for assimilating these basins and the number of deposits involved in their operation. While since the start of production of the Tyumen' petroleum field, only 18 highly efficient fields were assimilated, it will be necessary in the Tenth Five-Year Plan period to develop 30 fields. They will be more scattered, more remote from the present centers of production by hundreds of kilometers, and occupy huge areas among muddy northern swamps.

In the Kansko-Achinskiy Basin, one of the largest in the world, resources of coal (135 billion tons) suitable for strip mining, located in the uninhabitable Siberian forest-steppes regions, it is possible to concentrate mining in only several deposits. The mining-technical conditions for this are favorable here: the thickness of the primary working seam is 13 to 60 meters, the structure is simple and the beds are mostly horizontal. The overburden coefficient with low strength overburden rocks is 1.5 to $3m^3$ tons, while in most other basins, it is 5 to $16m^3$ tons. The unique concentration of reserves in the deposits (several open cuts may be established at each one with capacities of up to 50-60 million tons per year) makes it possible to use highly productive stripping and mining

* L. V. Semyenov, V. P. Davydov. "Economics of Chemical Reprocessing Coal." METALLURGY, 1972, p 194.

equipment such as Esh-15/90 and ESh-25/100 draglines, ERShRD-5250 rotor excavators, etc. All of this predetermines obtaining here the best technical-economic indicators of mining fuel in the country.

The reduced costs for mining the Kansko-Achinskiy coal per ton of conventional fuel are considerably lower than for producing petroleum and even natural gas. In the current five-year plan period, scientific research and planning-design organizations of the USSR Minugleprom [Ministry of the Coal Industry] will develop technology and equipment complexes of still greater unit capacity for creating open cuts with a productivity of labor 3 to 4 times higher than the level achieved in 1975 by the best enterprises in the industry under similar geological-mining conditions. Thus, at the planned "Berezovskiy No 1" open cut with a capacity of 55 million tons, the coal per miner will be 2000 tons per month. Here and in other possible open cuts, it is planned to utilize for stripping higher cutting power rotor excavators type ERP-12500 in combination with OShR-12500 swing chutes, EVG-100/70 mechanical shovels and ESh-80/100 draglines.

Yet, the rate of development of the Kansko-Achinskiy Basin did not correspond to its potential possibilities and efficiency of involving its resources in the national economy circulation. In 1976, the Kansko-Achinskiy coal amounted to less than 1 percent of the all-union mining of coal. The directives of the 25th party congress specified the creation of the Kansko-Achinskiy fuel-power complex. Especially urgent is the problem of efficient transportation of coal over long distances. Respective organizations are carrying out scientific research, experimental and planning work on new types of transportation (pipeline container systems, hydraulic transport), and on the technology of the primary reprocessing of Kansko-Achinskiy coals in order to raise their transportability and efficiency of utilization in the national economy.

It appears that one of the most promising solutions of the problem of assimilation of the Kansko-Achinskiy Basin may be the creation of the production of artificial liquid fuel. This would make it possible to meet local requirements in liquid fuel and a number of chemical products and free a considerable amount of Tyumen' petroleum, reprocessed in Siberia, for supplying regions which are in short supply. Liquid fuel is the most transportable of all fossil fuels. With an average calorific value of 10,500 kilocalories/kg, a ton of liquid fuel is equivalent to 3 tons of Kansko-Achinskiy coal. Thus, the ton-kilometer volume of transportation may be reduced to a third and less.

The use of liquid fuel grows faster in all economic regions than fuel as a whole due to the large absolute increase in the number of motor vehicles, the intensification of agriculture, etc. In the current five-year plan period, for example, it is planned to increase tractor output to 550,000-600,000 per year and the total power to 55 million horsepower. Therefore, the power of the tractor pool during the five-year plan period will exceed by 3 times the capacity of thermal electric power plants put into operation

during the same period. Some 9 to 10 million motor vehicles will be produced with the power of their engines counted in hundreds of millions of kilowatts. The 8900 diesel engines produced during the five-year plan period will be equivalent in power to about that of AES being put in operation.

This does not mean an equal increase in the use of fuel, since the coefficient of utilizing capacities in power plants and in mobile power installations is different. Water transport has an alternative power source in the future -- compact nuclear reactors. There are as yet no alternative solutions for planes. Chemical and other enterprises are being put in operation the production capacities of which are designed for operation during the next decades. The raw materials for them are petroleum and products of its reprocessing. Taking into account the technical base of the national economy planned for the future that determines the structure of using fuel-power resources, it is impossible not to consider one of the main problems for increasing the production of liquid fuel and raw materials in the future. The problem is -- are there technical and economic premises for producing artificial liquid fuel from coal?

From the national economic standpoint, the problem of saving petroleum in every possible way replacing it where possible, and increasing the resources of liquid fuel and raw materials by using other fossil fuel is extremely urgent. As pointed out in L. I. Brezhnev's report at the 25th party congress, "increasing the production of raw petroleum will give very little, if a considerable part of it is burned as fuel oil instead of being used for obtaining more valuable kinds of fuel, petrochemical products and increasing export resources."*

Report data on industrial and planning calculations indicate that more extensive reprocessing of raw petroleum makes it possible to raise the efficiency of a typical petroleum refining plant by many million rubles per year. This is due, first of all, to the fact that in the total costs of mining, transporting and reprocessing raw petroleum, the mining costs prevail.

Attention should be called to the fact that up to 9/10 of the capital investments are spent on extracting raw petroleum. As is well known, average-union unit capital investments in raising the production of petroleum in recent years are increasing constantly. At present, the rate of their growth accelerated. Regional costs increase sharply in connection with assimilation of petroleum deposits in zones sparsely populated and difficult of access. About 20,000 rubles are spent on capital construction per one new inhabitant in a nonproductive area in the Middle Ob' Region, and twice as much as in the Far North (Yamal Peninsula).**

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* "Materials of the 25th Party Congress." Moscow POLITIZDAT, 1976, p 59.
** PRAVDA, 1976, 20 April.

Considerable changes have also occurred in the geographic location of the coal production industry. In the current five-year plan period, 4/5 of the increase in solid fuel mining will be in Kazakhstan, Siberia and the Far East. However, while territorial shifts in the petroleum-gas industry lead to a sharp rise in capital investments and operating costs, the development of mining coal in eastern basins makes it possible to expect, in the future, its comparatively smaller increase because of such factors as the generally higher cost of equipment, higher expenditures for protecting the environment, etc. At the same time, there are factors that reduce unit capital investments when building new coal enterprises -- intensive changeover to strip mining and building open cuts of great unit capacity. Their ratio in the overall capacity being put into operation may increase in the future to 70 percent. Strip mining Ekibastuz coal and Kansko-Achinskiy lignite requires the lowest capital investments (4.7 to 12.0 rubles). The development of their mining in the future on a large scale will save several billion rubles compared to an increase in producing an equivalent amount of Tyumen' petroleum.

Reprocessing solid fuel will, without doubt, involve greater costs than reprocessing petroleum. While the low molecular structure, liquid state and high solubility of petroleum make its utilization easier, the high molecular nature, nonmelting and insolubility of the complex and multicomponent coal substance make its reprocessing difficult. However, the overall capital-intensiveness, taking into account investments in the raw materials base, must be considerably lower per unit of coal product than per unit of a similar petroleum product.

Moreover, under the planned economy system, it is possible to combine the reprocessing of coal and petroleum in any scales. There are technical-economic premises for this. Thus, the principal features of coal liquefaction technology developed by the Fossil Fuels Institute, using petroleum to form paste and a source of hydrogen are: hydrogen pressure is not greater than 100 atmospheres instead of the pressure previously used in industry (250 to 300 atmospheres); and a temperature of about 425°C instead of 480°C. Studies on continuous-flow installations showed that by reprocessing 30 percent of the petroleum along with coal, it is possible to liquefy 90 percent of the coal with a consumption of half the gaseous hydrogen when coal alone is used. The final products of reprocessing using the technology in petroleum reprocessing plants are: boiler fuel with a low sulfur content; AI-93 gasoline, fuel for high speed diesels; and chemical products, including very valuable phenols. The reduction in pressure when reprocessing coal will make it possible to increase the volume of reactors from 25 to 200m^3 and more; reduce the weight of the equipment and reduce capital investments in the production of artificial liquid fuel.

An enlarged experimental installation in the Kansko-Achinskiy Basin was designed in accordance with the directive of the USSR Minugleprom.

On the basis of the technology for combined hydrogenation of the Kansko-Achinskiy coal and Tyumen' petroleum developed by the Fossil Fuels Institute, the "Grozgipronefteklhim" Institute carried out in 1976 a technical-economic comparison of the expediency of producing liquid fuel in accordance with this technology and from petroleum alone. Comparing the interchangeable versions of the fuel reprocessing combine under conditions of the Krasnoyarskiy Kray, the reduced cost per ton of synthetic liquid fuels was found to be 20 percent lower than per ton of liquid fuel made from petroleum.

The savings in capital investments cover the additional costs of apparatus for reprocessing coal which is more complex than that for reprocessing petroleum and makes it possible to reduce the overall volume of capital investments in producing an equivalent amount of products. Evaluating realistically the maximum possibility of developing the strip mining of lignite in the Kansko-Achinskiy Basin, it is possible to count on fully satisfying the liquid fuel requirements of a number of eastern regions (by reprocessing a part of the coal). This will make it possible to increase the supplies of Tyumen' petroleum to the European part of the country considerably. Thus, the development of mining and reprocessing of Kansko-Achinskiy and other coals will facilitate directly and indirectly the optimization of the fuel-power balance of the country and higher productivity of social labor.

An analysis of the achieved results, as well as of the trends in developing research in the area of chemical technology of solid fuel makes it possible to make a conclusion about the great potential possibilities of utilizing coal as an organic raw material. On the basis of studying the structure of a petroleum molecule and a hypothetical macromolecule of coal, theoretical chemists think that reprocessing coal by new methods will make it possible to produce a wider assortment of products from coal than from petroleum and by traditional coking. The fundamental research has been done and ways have been found for the direct conversion of the organic substances of coal into promising carboniferous materials, valuable chemicals and other products needed by the national economy. This makes it possible to count on further wide utilization of coal resources in new directions.

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PRESCHOOL EDUCATION NETWORK EXPANSION IN THE 1960-1976 PERIOD

Moscow DOSHKOL'NOYE VOSPITANIYE in Russian No 7, Jul 77 pp 37-42

[Article by A. Zaporozhets, T. Markova and V. Reutova: "Development of the Preschool Education System in the Period of Developed Socialist Society"]

[Text] Preschool education has been faced with new tasks in the stage of developed socialist society -- to ensure full satisfaction of the workers' need for public education of children of preschool age. The industrial enterprises and organizations and the kolkhozes and sovkhozes have participated actively in carrying out this task. During the 1959-1965 Seven-Year Plan, the number of children in USSR preschool institutions increased 1.7-fold, and the number in the Ukraine -- 2.6-fold, and in Belorussia -- more than two-fold. However, the number of kindergartens available has not met the growing demands of the urban and rural population.

With a view towards developing the network of preschool institutions further, the 23rd Party Congress, after approving the assignments for the Eighth Five-Year Plan, outlined "increasing the number of children in state preschool institutions to 12.2 million...."[1] As a result of measures aimed at carrying out the Congress resolutions, during the Eighth Five-Year Plan, the enrollment in preschool institutions increased by 1,608,000 children.[2] However, in spite of the significant increase in the number of children being reared in the nation's preschool institutions, the state plan for construction of kindergartens and day nurseries was not fulfilled. Nonfulfillment of the assignments set for expanding the network of preschool institutions was a result of underestimation by certain enterprise, institution, sovkhoz and kolkhoz leaders of the importance of creating conditions appropriate to the organization of preschool education.

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1. "Materialy XXIII s"yezda KPSS" [Materials of the 23rd CPSU Congress], Moscow, Politizdat, 1966, p 262.

2. A calculation made by the authors based on data from the handbook "Narodnoye obrazovaniye, nauka i kul'tura v SSSR" [Public Education, Science and Culture in the USSR], Moscow, Statistika, 1971, p 128.

In accordance with the directives of the 24th CPSU Congress, preschool institutions holding more than 2.2 million children were built during the Ninth Five-Year Plan. By the end of 1975, 11.5 million children were being reared in full-time preschool institutions in the USSR, and seasonal children's institutions encompassed about five million preschoolers. In the Russian Federation alone, kindergartens and day nurseries with room for 1,152,000 children were built during the Ninth Five-Year Plan, including facilities for more than 120,000 children built by kolkhozes; by the end of the five-year plan, the enrollment in state preschool institutions had increased from 5.6 million children in 1970 to 6.5 million. As of 1 January 1976, there were 68,600 children's preschool institutions in the RSFSR belonging to all ministries and departments, including kolkhoz ones. They were rearing 6.65 million children of nursery and preschool age. The highest provision of preschool institutions has been achieved in the Central economic region -- 54 percent, the East Siberian -- 48 percent, and the Northwest and Far East -- 60.8 percent. The lowest is in the Central Chernozem region, where it is 34.3 percent. In 1976, 48.9 percent of all children of preschool age in the Russian Federation were being reared in kindergartens and day-nursery centers, including more than 83 percent of those in the capital, 70.5 percent of those in the Karelian ASSR, 75.4 percent in the Komi ASSR, 82.7 percent in Murmanskaya Oblast, 70.9 percent in Sakhalinskaya Oblast, and so forth.

The councils of ministers of the Udmurt and Yakut ASSR's, the Primorskiy krayispolkom, and the Volgogradskiy and Permskiy oblispolkoms fulfilled and overfulfilled plans for the start-up of preschool institutions every year in the Ninth Five-Year Plan. New day-nursery kindergartens have been built at outstripping rates in regions of the North, Far East and Siberia and in new urban settlements under construction. Much attention has been paid to reinforcing the material and technical base of children's preschool institutions, to improving education and to providing preventive medical services to children. During the period from 1960 through 1975, the number of day-nursery kindergartens increased from 4,100 to 35,800, but the demand for them remains high. In 1976, about 60 percent of the first-year primary school pupils were previously enrolled in kindergartens.

The following data [table on page following] testify to the development of the children's preschool institution network in the USSR.

By the end of 1975, there were 99,000 kindergartens and day-nursery centers with an enrollment of 10.47 million children.

An analysis of the data in the table bears out the steady growth in enrollment in preschool institutions and in the number of such institutions. It should be noted in this connection that over the last 15 years, as is evident from the table, there has been a clear trend towards more kindergartens and higher enrollments, with a simultaneous significant reduction in the number of day nurseries and in their enrollments.

However, the existing network of children's preschool institutions still does not meet fully the demand for them.

Development of Full-Time Preschool Institutions in the USSR (at end of year)

year	number of full-time preschool institutions			children enrolled (in thousands)		
	total	including		total	including	
		kindergartens*	day nurseries		kindergartens*	day nurseries
1960	70,584	43,569	27,015	4,428	3,115	1,313
1965	91,887	67,537	24,350	7,673	6,207	1,466
1970	102,730	83,134	19,596	9,281	8,100	1,181
1974	112,451	96,257	16,194	10,978	9,906	1,072

[* these are kindergarten-day nurseries combined]

In the resolutions of the 25th CPSU Congress, which are aimed at steady improvement in the prosperity of the Soviet people, increasing importance has been acquired by further improvement in the system of preschool education, by constant enlargement of the network of day-nursery/kindergartens and comprehensive improvement in their activity.

A special place in the preschool education system is occupied by institutions for rearing physically handicapped children and mentally and physically retarded children. Kindergarten-sanitoria continue to be opened for physically handicapped children; they operate as independent boarding-school type institutions for the treatment and development of children with early manifestations of tuberculosis intoxication and those with mild and quiescent forms of tuberculosis. Special preschool institutions equipped with the necessary equipment and apparatus are being created for mentally and physically retarded children; a program of treatment and development is provided for abnormal children.

Growth in the network of children's preschool institutions and in their enrollments has been accompanied by improvement in all study-development work. First of all, in accordance with the CPSU Central Committee and USSR Council of Ministers Decree "On Steps to Develop Children's Preschool Institutions and Improve the Education of and Medical Services for Children of Preschool Age" (1959), a "Children's Education Program" for children ages two months to seven years was worked out and published in 1962; it was the first such program and was developed on the basis of scientific research and leading practical experience for a new type of preschool institution, the kindergarten/day nursery. This program defined the range of accomplishments, abilities and practical skills to be mastered by children of different ages and described the personality attributes which must be developed.

As distinct from the previously published "Guides," the program requirements in the new program were separate from the methods instructions. The education program was also substantially different in its structure. Program

tasks are to be carried out in the children's activity -- in games, exercises, everyday life, and in those forms of labor activity accessible to children. The program singles out that group preparing for school. At the same time, it contains a new section revealing the tasks, content and forms of rearing young children (ages two months to two years).

The practical introduction of the indicated "Program of Kindergarten Education" into public preschool education has permitted a substantial rise in the level of study-development work in day nurseries and kindergartens, significant improvement in the preparation of children for school instruction, and the organization of a closer link with and the continuity of education of children of preschool age and younger.

Subsequently, in connection with the switch to three-year primary instruction, this program was substantially reworked. In drawing up the improved program (1969), consideration was given to the fact that the modern school requires of children entering the first grade greater physical and mental efficiency, more complex forms of analysis-synthesis activity, and a higher level of moral and volitional development than had been required of six-year olds in the recent past. The "Program of Kindergarten Education," and especially the content of study-development work in the preparatory group, was therefore improved in the direction of raising the level of overall development of children, of developing the ability and desire to study. During the course of this work, consideration was given to the results of research done by associates of the USSR Academy of Pedagogical Sciences' Scientific Research Institute of Preschool Education in the area of the genesis of cognitive activity in early childhood, of the patterns of physical development, the features of preschool instruction and its effect on the child's mental development, the formation of moral concepts, feelings and attitudes among children, the interrelationship between instruction and independent artistic creativity in the aesthetic development of the preschooler, and so forth. Introduced into the education programs adopted by the Union republics were local changes reflecting their language, national, customs and geographic peculiarities.

The transfer of kindergartens to operation under the new program has yielded positive results. The 1970-71 and 1972-73 surveys of large kindergartens and day nurseries, using specially developed diagnostic methods, disclosed that six-year olds entering school from kindergarten had reached a higher level of physical, mental, moral and aesthetic development than in pre-war years.

One direction in which the study-development work of the preschool institutions has been improved and the theoretical skill of preschool education workers has been improved is the publication of methods aids and recommendations on various questions of physical, mental, moral and aesthetic education in kindergarten and in the family; these aids and recommendations were prepared by associates and teachers of the chairs of preschool pedagogy of the pedagogical institutes and by activists in public education agencies. During the Ninth Five-Year Plan alone, 64 methods titles for

preschool education, in a printing of 10.5 million copies, were published to help educators and education leaders. In particular, the Institute of Preschool Education prepared a basic aid for educators and methodologists, "Vospitaniye i obucheniye v detskom sadu" [Education and Instruction in the Kindergarten],[1] which encompasses the basic methods questions of physical, mental, moral and aesthetic education in all kindergarten age groups. Since 1972, Prosveshcheniye Publishing House has published 20 titles in the "Kindergarten Educator's Library" series, and releases in this series will continue in the Tenth Five-Year Plan.

In connection with improving work content and methods in preschool institutions, scientific research in the area of the pedagogy, psychology and physiology of the preschool age group has been greatly expanded in recent years to include not only the laboratories of the USSR Academy of Pedagogical Sciences' Institute of Preschool Education, but also other scientific institutions in the country. Scientists from the Union republics are participating actively in the unified creative process of developing the theory and practice of Soviet preschool education.

A broad range of problems of the physical, mental, moral and aesthetic education of preschoolers, the preparation of children for school, mastering native and Russian languages, opportunities for teaching six-year olds in kindergarten and in school, and so forth, is being developed in the chairs of preschool pedagogy of the pedagogical institutes, in the central methods offices, and in the scientific research institutes of the schools and of pedagogy and psychology of the Union republics. The development of questions of physical, moral and mental education of preschoolers has broadened in scope in the Ukraine, Belorussia, Armenia, Georgia, and the Central Asian and Baltic republics. Research on questions of the development and education of young children has been conducted in Uzbekistan, the Ukraine, Armenia, Estonia and Kazakhstan.

Recently, special attention has been paid to problems of teaching and rearing six-year olds. Pedagogues, physiologists and psychologists have discussed these questions heatedly, expressing different impressions regarding the psychological and physiological potential of six-year old children, of how and in what they should be taught, and of whether it is more appropriate to instruct them in kindergarten or in school. In Azerbaydzhan, Georgia, Lithuania, Estonia, Kirghizia, Belorussia and the Ukraine, much attention is being paid to problems of the aesthetic development of preschoolers using music, pictorial art and literature. Of substantial importance to the development of preschool education theory has been the research conducted in the Union republics on child psychology, among which particular notice should be paid to research by D. N. Uznadze and his followers in the Georgian SSR, G. S. Kostyuk and his associates in the Ukrainian SSR, and also a number of other studies done by psychologists in other Union republics. Scientific research in preschool pedagogy, psychology and physiology have

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1. Edited by A. V. Zaporozhets and T. A. Markova, Moscow, Pedagogika, 1976.

helped raise the level of all study-development work in preschool institutions and improve the system of public preschool education in our country.

Improvement in educational work in preschool institutions on the basis of new scientific achievements has required improvement in the training of pedagogical cadres for them. During the Ninth Five-Year Plan alone, VUZ's and pedagogical schools trained upwards of 80,000 specialists in preschool education, and another 56,000 educators received special training by correspondence. Not only were more specialists in preschool education graduated, but there were also qualitative changes in the nature of their training. In particular, a new study plan was developed for training broadly specialized educators in the pedagogical schools so as to enable these teachers to work not only with preschoolers, but also with younger children. This is a four-year course based on the eight-year school. Pedagogical higher academic institutions have also begun graduating more specialists for preschool institutions. In 1975, more than 100,000 graduates of the nation's pedagogical institutes were working in kindergartens (in 1965, only 36,000 pedagogues with a higher education were working in preschool institutions). The quantitative and qualitative composition of these educators were both improved. Whereas in 1970 some 359,800 educators and educational leaders were working in kindergartens and day nurseries, in 1975 they numbered more than 430,000, of which 66,200 had a higher or incomplete higher education.

The training and retraining of cadres for preschool institutions has been done not only in the pedagogical schools and institutes, but also through the network of medical institutes and schools and the institutes for requalifying teachers and methods offices. Moreover, broad scope has been achieved by work to improve the skills of preschool worker cadres through courses, seminars and pedagogical lectures. Growth in the pedagogical skill of cadres has raised the effectiveness and level of the great diversity of all work on rearing children of preschool age to a new level.

In the period of developed socialist society, there has been considerable development of kindergartens and day nurseries in rural areas. These institutions not only enable women who are mothers to participate actively in social production, but also work hard on comprehensive development of the children, which is very important to their instruction in school. It should be noted that rural preschool institutions are switching increasingly from providing seasonal services to year-around operation.

Preschool institutions are being built everywhere. In the 1966-1970 period, kolkhozes and sovkhozes built preschool institutions for 600,000 children. In 1970, upwards of 7,414 full-time and seasonal preschool institutions with enrollments exceeding 2.5 million children were operating in the nation's kolkhozes and sovkhozes. During a three-year period (1966-68), kolkhozes and sovkhozes in the Kirghiz SSR built preschool institutions for 10,000 children. The construction of kindergartens has been particularly successful in villages in Talasskiy, Kantskiy and Chuyskiy rayons. In 1970, some 27.06 million village children in the republic were being reared in preschool

institutions with a good material base. The buildings were constructed following standard designs which meet pedagogical and hygienic requirements and which take local conditions into account.

During the Ninth Five-Year Plan, the number of rural preschool institutions has increased noticeably. Thus, in the RSFSR during those years, preschool institution coverage in rural areas increased from 20.3 to 31 percent. In such oblasts as Sverdlovskaya, Moscow, Leningradskaya, Kirovskaya, Kurganskaya, Permskaya and in Krasnodarskiy Kray, preschool institution coverage was from 40 to 62 percent. In 1974 and 1975, our villages received about 1,000 institutions with room for 90,000 children. On sovkhozes in Altayskiy Kray, for example, the network of preschool institutions was increased by 5,800 seats during the Ninth Five-Year Plan. In 1975, there were 429 preschool institutions, rearing 17,900 children, on the kray's 371 sovkhozes. During these years, the kolkhozes opened 2,920 seats, with a plan of 2,730 seats, which was 106.9 percent of the plan assignment. In many areas of Moscow, Leningradskaya, Belgorodskaya, Kalininskaya, Rostovskaya, Omskaya and Gor'kovskaya oblasts, Krasnodarskiy Kray and elsewhere, such institutions operate at the level of the best urban children's institutions.

During the Ninth Five-Year Plan, the number of preschool institutions on kolkhozes and sovkhozes of the RSFSR Ministry of Agriculture increased by 242,300 seats. In Moldavia, the network of full-time kindergartens on kolkhozes and sovkhozes increased three-fold, and their enrollment 2.4-fold, during two years (1972-74) of the Ninth Five-Year Plan. Here, the task of maximum coverage of six-year olds by public education is being solved successfully. Preparatory groups, in which qualified educators work with the children, have been created at all full-time preschool institutions in Moldavia. In the Uzbek SSR, nearly all kolkhozes and sovkhozes have a kindergarten, and several of them have several preschool institutions. Preschool institutions are being developed successfully on kolkhozes and sovkhozes in Turkmeniya, Kirghiziya, Kazakhstan and Tadzhikistan.

However, in spite of the successes which have been achieved, development of the network of rural preschool institutions lags considerably behind the development of urban preschool institutions, and the existing network does not meet the needs of agricultural workers. In rural areas, far fewer children are covered by kindergarten and day-nursery services than in the cities.

Rural preschool institutions are basically still understaffed, so the [preparatory] groups are supplemented with two- and three-year olds, which lowers the level of the study-development work.

An important factor in drawing the development level of rural children closer to that of urban children is significant enlargement of the network of rural preschool institutions, strengthening their material and technical base, improving the quality of study-development work, and further growth in the cultural and educational levels of rural educators. To this purpose, in 1973 the USSR Council of Ministers adopted a Decree "On Steps to Develop Further

the Network of Children's Preschool Institutions On Kolkhozes," which was aimed at expanding and strengthening the network of kolkhoz preschool institutions.

To implement the indicated decree, a series of specific steps aimed at improving the material and technical base of rural preschool institutions and perfecting the pedagogical process in them was developed. A considerable number of girls were sent from rural areas to study at preschool pedagogical schools using kolkhoz funds, and preschool pedagogical school graduates were sent to work in rural preschool institutions. Much attention is now being paid to propagandizing and disseminating leading pedagogical experience. In particular, the measures outlined anticipated the organization of competition between oblasts, rayons and kolkhozes for the best work organization in enlarging the network and strengthening the material base of preschool institutions on kolkhozes; a Union-wide review of kolkhozes and sovkhozes to find the best rural public preschool education organization; study, generalization and dissemination of leading experience in kolkhoz kindergartens; extensive publicity in the pedagogical press for the work of the leading kolkhoz preschool institutions; urban kindergarten sponsorship of rural kindergartens, and so forth.

Implementation of the measures outlined has permitted a certain improvement in the staffing of kolkhoz kindergartens with skilled cadres. In 1975, for example, 65.8 percent of the workers in rural preschool institutions (50.3 percent on the kolkhozes) of the Russian Federation had a special education. In particular, upwards of 80 percent of the kindergarten educators and educational leaders had a special education in Leningradskaya, Kalininskaya, Vologodskaya and Sakhalinskaya oblasts, in Stavropol'skiy Kray, and in the Severo-Osetinskaya and Komi ASSR's.

In accordance with the CPSU Central Committee and USSR Council of Ministers Decree "On Steps to Develop Further the Agriculture of the RSFSR Nonchernozem Zone" (1974), a major program was outlined for transforming the villages and hamlets, for building general schools and preschool institutions in them. In connection with the intensive process of population concentration in the large population centers, the plan for building preschool institutions in those centers in 1976-1980 anticipates only the construction of day-nursery/kindergarten buildings utilizing new standard designs.

The resolution of complex, urgent tasks on continued development of the system of rural preschool institutions and improving the study-development process in them has required that a number of scientific investigations be conducted in this area.

Associates of the USSR Academy of Pedagogical Sciences' Scientific Research Institute of Preschool Education have run a special project devoted to the organization of preschooler activity and education in the rural kindergarten. One result was the creation of programmed-methods instructions for seasonal preschool institutions. These documents define the amount of knowledge,

abilities and skills to be mastered by children in 6-8 months in a seasonal kindergarten. "Pedagogical Recommendations" were developed which examine questions of organizing the activity of kindergarten children of different age groups: exercises, leading games and labor development, and so forth. This aid will help us organize educational work properly in understaffed kindergartens.

The republic and oblast methods offices of all the republics have worked out and sent to the rural kindergartens a large number of recommendations on various questions of child education. The Prosveshcheniye Publishing House, together with the RSFSR and USSR Ministries of Education, began publishing in the Tenth Five-Year Plan a new subscription library, "The Rural Kindergarten." These books will help workers in preschool institutions to solve organizational and methods problems of educating children of preschool age in rural areas.

Along with growth in the network of rural preschool institutions, educational work with the children has been improved noticeably and the methods skill of their teachers has grown. The results of the Union-wide review of kolkhozes and sovkhozes to find the best rural public preschool education organization bear eloquent testimony to the fact that party and soviet organizations and the kolkhozes and sovkhozes have done much not only to develop the network of preschool institutions, but also to create good conditions for the activity and education of rural children. The best kolkhozes and sovkhozes were given awards and incentives.

The directives of the 25th CPSU Congress on further developing USSR public education have opened up major opportunities for further developing public preschool education in both urban and rural areas. New preschool institution construction will proceed even faster than before. For example, day-nursery/kindergartens for 317,000 children will be built in the five-year period just through state capital investments in sovkhozes and other state agricultural enterprises in the RSFSR. Construction will be particularly broad in scope in regions of the Nonchernozem Zone and in Siberia. Implementation of the outlined program will enable us to sharply reduce the gap in providing rural children with full-time preschool institutions by the end of the five-year plan and will enable us to create conditions most favorable to the organization and conduct of sanitation and educational work with children.

In the period of construction of developed socialist society and preparation for the transition to communism in our country, major successes have been achieved in public education of children of preschool age. The preschool education system of the Soviet Union plays a socioeconomic, pedagogical and medical-hygiene role in the life of our society: it offers women who are mothers an opportunity to engage in productive labor, to raise their cultural level, to participate actively in the nation's social-political life, and at the same time, it offers skilled concern for the health and comprehensive education of the young child.

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METALLURGY AND MINERALS

PROBLEMS IN FERROUS METALLURGY

Moscow EKO, EKONOMIKA I ORGANIZATSIYA PROMYSHLENNOGO PROIZVODSTVA in Russian
No 3, 1977 pp 128-147

[Article by V. I. Cheplanov, doctor of economic sciences, professor, chief of the General Economics Department of the Government Committee on Prices of the USSR Council of Ministers; M. K. Sorokina, group manager of the Economics Institute of the Moscow Central Scientific Research of the Ferrous Metallurgy Institute imeni I. P. Bardin]

[Text] The October (1976) Plenum CC CPSU devoted a great amount of attention to the state and prospects of ferrous metallurgy in the USSR. L. I. Brezhnev stressed in his speech at the Plenum the following: The radical solution of the problem of meeting continuously the growing demands of the economy in metal will require great efforts in raising the efficiency of the industry. The reserves here are tremendous. Continuing the discussion of the urgent problems of ferrous metallurgy began in 1974 (No 4) and in 1976 (No 3) , the editor calls the attention of the readers to the following article dedicated to reserves of raising the efficiency of ferrous metal production.

In 1961-1975, the development of ferrous metallurgy in the USSR was characterized as a whole by positive technical-economic indicators. The quality of metal output increased and, on this basis, metal-intensiveness in all social production decreased. Because of this, it was not necessary to raise the rates of production of ferrous metals as much as the rates of development of the entire national economy, as well as of metal-consuming sectors of industry.

Thus, the output of the entire industry increased 3.3 times in 1961-1975, in machine building and metal working -- 5.2 times, while in ferrous metallurgy -- only 2.5 times. Correspondingly, the ratio of ferrous metallurgy in the total industrial output, and with respect to machine building, continued to fall during these 15 years. It is also possible to draw another conclusion: the efficiency of ferrous metallurgy increased during these years -- its output of machines and other products per ruble increased more and more.

A still more favorable relationship is shown by a comparison of the gross output of industry with the change in the nature of ferrous metals. For example, an increase of 2.3 times in the production of finished rolled stock provided an increase of 3.3 times in the output of industry and 4.5 times in the output of metal working.

The volume of metal output per person increased at a high rate from year to year. In 1940, 94kg of steel per person were produced, in 1970 -- 477kg, and in 1975 -- 555kg. The USSR approached developed capitalist countries in the production of metal per person. The higher efficiency of ferrous metallurgy is also demonstrated in the growing metal stock of our country. The metal stock more than tripled since 1960 and is, on the average, about 4600kg per person.

The development of ferrous metallurgy however, also has its difficulties. The economic indicators of this sector which characterize the efficiency of production are deteriorating.

Thus, the cost of the production of ferrous metallurgy during the last three five-year plans practically did not decrease. The change in the cost per 1 ruble of commercial output in 1961-1965 was 0.9 percent in comparable prices. During the Eighth Five-Year Plan period, the costs per 1 ruble of commercial output decreased by 0.4 percent, while at the end of the Ninth Five-Year Plan period they were at the level of 1970.

The rise in fixed capital in ferrous metallurgy is considerably above the rise in commercial output and profit. In the Eighth Five-Year Plan period, for a rise of 38 percent in the rise of fixed production capital, the rise in commercial output was 21 percent and profit -- 20 percent. The profitability with respect to fixed production capital was 17.2 percent in 1970. In the Ninth Five-Year Plan period, for a rise in fixed capital of 58.3 percent, the volume of commercial output increased by 28.7 percent and profit -- by 7.3 percent. The profitability ratio to fixed production capital in 1975 was 11.8 percent.

Since 1960, the output-capital ratio has had a stable trend toward lowering and was 30 percent lower in 1975 than in 1965. The capital-output ratio of commercial products produced by new equipment is more than double that of products produced on old equipment.

Considerable capital investments were directed to ferrous metallurgy in recent years. Unit capital investments per ruble of increase in commercial output in the industry as a whole increased by 52 percent in 1970 compared to 1965 and by 27 percent more in 1971-1975.

As a result of the rapid growth of fixed capital during the last 15 years, amortization deductions increased sharply to 9.1 percent of the expenditures. The rise in amortization costs is considerably above the savings obtained from raw materials, materials, fuel and higher productivity of labor.

In connection with the reduction in the ratio of wages in production cost from 20 percent in 1960 to 10 percent in 1975, the higher rise in the productivity of labor than in wages had an insignificant effect on reducing the cost of production.

Improvement in the economic indicators in the industry is not expected in the very near future. Thus, the output-capital ratio in 1980 will be lower than in 1975 and the profitability with respect to fixed production capital will also be lowered.

The Effect of Objective Factors

The dynamics of the basic indicators of the efficiency of ferrous metallurgy production are a result of a number of objective and subjective factors. The most important objective factor which reduces the efficiency of ferrous metallurgy is the change in the structure of production in the industry. It is characterized by the increase in the ratio of output that has a lower output-capital ratio and a relatively low profitability.

The ratio of the ore mining industry increases in the volume of commercial output and in the total cost of fixed production capital. This reflects negatively on the output-capital ratio and other economic indicators because the profitability and output-capital ratio of the ore mining industry is less than half that in the industry as a whole. The ratio of the fixed production capital costs of the ore mining industry, including the iron ore shops of metallurgical combines, is more than 30 percent, while the ratio of the subsector in the volume of commercial output is about 8 percent. Over 15 percent of the workers in the industry are occupied in mines and strip mining.

With existing prices for metal products suitable for the national economy, the improvement in the quality and the expansion of the assortment of products reduces the industrial indicators of production efficiency. An increase in the production of thin sheet steel and, especially, of cold rolled steel and fourth conversion products requiring several technological cycles facilitates the rise in the cost of production and the capital-output ratio of metallurgical production. According to the data of metallurgical enterprises, the output-capital ratio for sheet steel is 35 percent lower than that for structural steel.

Raising the level of combined production leads to the reduction of the repeated count of the volume of output and to a lower rate of growth of gross and commercial output compared to the growth of the output expressed in natural units, and the growth of fixed capital. As a result, the output-capital ratio is reduced. The ratio of capital investments directed for protection against air and water pollution increases.

The mechanization and automation of production processes with their present efficiency cannot provide a rise in output at the same rate as the rise in capital. Expenditures for mechanization and automation of labor processes in ferrous metallurgy pay for themselves very slowly and frequently appear inefficient due to the lower evaluation of live labor. Ferrous metallurgy is now in fifth place among industries with respect to the level of wages.

Rapid development of ferrous metallurgy requires the processing of greater and greater amounts of raw materials. As sources of high quality and low quality raw materials are being exhausted, lower quality raw materials are being used. The KMA [Kursk Magnetic Anomaly] , the Krivoy Rog Basin, and the Kachkanarskiy and Sokolovsko-Sarbayskiy Mining Enriching combines occupy a decisive place in supplying ferrous metallurgy of the USSR with ore. This iron ore base has complex mining-geological conditions of the deposits, which require greater depth of underground mining and increase the overburden coefficient of strip mining. All of this leads to high production costs of iron ore raw materials. The assimilation of iron ore deposits with low iron content in the ore increases the consumption of raw materials ore per ton of concentrate. While in 1960, 1360kg of raw ore were consumed per ton of commercial ore, 1875kg are used now. A reduction in the iron content in raw ore from 44.6 to 36 percent increases the consumption coefficient by 37.9 percent.

Production costs also increase in connection with the greater role of the eastern and northern regions in the country in the total commercial output of ferrous metallurgy since the unit capital investments in the East and North are 10 to 15 percent higher and the production costs are 15 to 20 percent higher than in the South and Center.

Potential Possibilities of Technical Progress and Their Realization

The reduction in the efficiency of the development of the industry is also due to the fact that, in our opinion, insufficient attention is given to the utilization of the achievements of science and engineering in the production technology of ferrous metals.

The introduction of scientific achievements must provide such directions of scientific-engineering progress and the selection of such technology as would resist the deteriorating objective conditions of the development of ferrous metallurgy. During several decades the improvement in the technology of ferrous metal production followed the path of raising the capacities of metallurgical units, intensifying technological processes by using oxygen and natural gas, developing various methods of remelting, etc. However, there are still no industrial developments for the direct reduction of iron from ore (eliminating blast furnace production); obtaining metal by electrolysis is not assimilated and there is no technology for a continuous metallurgical process, which are, as shown by calculations, the most efficient methods. Nuclear power is still not in use in ferrous metallurgy. Equipment for direct reduction of iron from ore for the Novo-Oskol'skiy Metallurgical Combine had to be bought by the USSR from the FRG.

Technological developments carried out by scientific research institutes are not subordinated to the main goal -- raising the efficiency of production. Many developments are introduced in practice without sufficient technical-economic substantiation which reduces their effectiveness. Only those processes and only that technology must be chosen from fundamental scientific investigations which could provide the national economy with an effect expressed in reducing norms for the consumption of raw and other materials, fuel, power, raising the productivity of labor, and reducing the cost of equipment and production.

The most efficient scientific developments are being introduced slowly and, therefore, do not have the proper effect on the national economy. Continuous steel casting may serve as a graphic example. For a long time, the USSR occupied a leading place in the world in developing this technology. The license for continuous steel casting installations was sold to many countries, including capitalist countries. However, as a result of our slow introduction and assimilation of this method, the United States and Japan overtook the Soviet Union in the volume of steel production cast by the UNRS [Installation for Continuous Casting of Steel] . The Novolipetskiy Metallurgical Plant equipped with such installations in combination with an oxygen-converter shop did not produce the necessary output for a long time either in volume of production, or quality of the output.

As a result of the slow introduction of scientific developments directed to saving raw and other materials and fuel, especially saving metal in rolling stock production -- the norms for consumption of raw and other materials and fuel in ferrous metallurgy are being reduced at insufficient rates. Yet, raising the efficiency of utilization of material consumption, which accounts, on an average, for about 80 percent of the production costs of metal products, is an important factor in reducing production costs in ferrous metallurgy.

As essential factor which reduces the efficiency of ferrous metallurgy development is the shortcomings in planning new metallurgical enterprises. The plans do not substantiate the efficiency of new enterprises sufficiently; they use low rated production costs and low fixed capital costs of metallurgical facilities. Miscalculations in planning express themselves in longer repayments and high production costs of the products. It is sufficient to say that not one converter shop built in 1966-1970 has as yet reached the rated production cost of steel.

In recent years, the following facilities were built: the largest blast furnace in the world with a useful volume of 5000m^3 at the Krivoy Rog Metallurgical Plant; a "3600" mill equipped with advanced equipment and technology at the "Azovstal'" Plant; a high productivity, modern "2000" sheet steel mill at the Cherepovetskiy Plant, new powerful converters in combination with a continuous steel casting installation at the Novolipetskiy Plant; a shop for manufacturing cold rolled transformer steel at the Verkh-Isetskiy Plant; a shop for manufacturing large diameter pipes at the

Khartsyzskiy Plant and other modern units. Nevertheless, products are manufactured at the latest units using more live and reified labor than average for the industry. The increase in the ratio of modern plants and units in the production of ferrous metals does not facilitate a reduction in the production cost of metal products but, on the contrary, reduces the economic indicators of the industry. Thus, the output-capital ratio on the new units is almost half that of the average for the industry.

It would appear that the existing practice of planning is directed toward substantiating as large a volume as possible of capital investments. The effort to put into the plans all the possible achievements of scientific ideas and of advanced practice is correct in itself. However, the planners are not concerned at what price the achievements are being introduced and create plans with considerable reserves which, as a rule, are not utilized.

It recently became a rule that a new ferrous metallurgy facility now costs considerably more than a similar facility before. The capital-output ratio of a ton of transformer steel of the cold rolling shop at the Verkh-Isetskiy Plant is higher by 32 percent than that of a ton of transfer steel at the Novolipetskiy Plant. The existing order in which planning organizations are financed in accordance with the cost of the project stimulates them to raise the cost of the facilities because all the economic indicators, expansion of production, hiring of personnel and raising wages depend entirely on the cost of the released facilities.

Projects with facilities for all conversions of metallurgical production, taking into account all the reserves built into them, make it possible for the USSR Ministry of Ferrous Metallurgy [Minchermet] to come to the USSR Gosplan and other organizations with justification for considerable volumes of capital investments. As was shown above, the rate of growth of new capital investments in ferrous metallurgy in the last three five-year plan periods was 1.5 to 2 times higher than the rate of growth of commercial output, i.e., in each five-year plan period new capital investments produced only half of the output-capital ratio and were considerably less profitable than the existing facilities. According to the data of the Ferrous Metallurgy Information Institute, the construction of modern metallurgical plants in Western Europe required unit capital investments per ton of annual capacity of steel of 300 dollars (225 rubles in accordance with the official exchange), in United States -- 400 dollars (300 rubles), in Japan -- 200 dollars (150). They were more than 450 rubles in the USSR.

The average construction time of a plant with a full metallurgical cycle and a 3 to 3.5 million ton steel output does not exceed 3 years in Western Europe, Japan and the United States. The construction time of a metallurgical plant of a similar type is considerably longer here. The violation of construction time norms leads to a higher volume of incomplete construction which reflects negatively on the indicators of the efficiency of utilization of fixed capital and capital investments. While the norm volume of incomplete construction in ferrous metallurgy must be 60 to 65 percent of the capital investments, actually this indicator was 89.3 percent in 1965;

106.6 percent in 1968; and 99.6 percent in 1973. An increase in the construction time of metallurgical facilities by 10 percent, as shown by calculations, leads to a rise of 1 to 2 percent in the cost of construction-installation work.

Not only construction-installation work, but also equipment has become more expensive. The existing practice of establishing prices for it, taking into account weight, led to an increase in the metal-intensiveness of metallurgical equipment and its cost. As a rule, it is prices not from price lists, but in accordance with individual prices which cover fully all expenditures of suppliers for developing new equipment. As a result, prices for individual equipment are 2 to 3 times higher than prices approved by the Government Committee on Prices of the USSR Council of Ministers. At the same time, the USSR Minchermet has no organ which would monitor prices, tying them in with prices for similar equipment established in price lists, and watch the cost of new equipment and its correspondence with the design calculations. This seemingly free capital for the industry results in considerably higher unit capital investments and lower efficiency of production.

The untimely assimilation of rated capacities of the basic metallurgical units affects the efficiency of the operation indicator of ferrous metallurgy. Thus, it took 8 years to achieve the rated capacity of the expensive "2000" sheet rolling mill at the Novolipetskiy Metallurgical Plant. The basic reason for untimely and incomplete assimilation of rated capacities of metallurgical facilities is incompleteness of construction and operating the facilities under conditions different from those assumed in calculating rated capacities.

A review of technical and project solutions proposed by the Minchermet for introduction in the future does promise neither revolutionary shifts in the technology, nor in the organization of production. It is proposed to preserve existing trends in technical progress in ferrous metallurgy: put in operation high productivity facilities, modernize existing facilities, eliminate outdated equipment, and use traditional methods for manufacturing ferrous metals. This may lead to a further reduction in the efficiency of ferrous metallurgy.

The considerable increase in the stock of metal in the USSR poses the problem of metal regeneration which is considerably cheaper and more efficient than mining ore, reprocessing it and obtaining new metal. Regeneration is almost 3 times cheaper than obtaining metal by using the existing technology: the mining of ore-agglomeration-the coking of coal-blast furnace processes-steel smelting production-rolling. In the future, the volume of the stock of metal and the possibility of regenerating metal will make it possible to reduce considerably the mining of ore, coking coals, their preparation for agglomeration and coking, and blast furnace production. The problem will arise of rebuilding steel smelting production for reprocessing scrap in electric furnaces. These structural shifts in the production of ferrous metals must be properly evaluated today, otherwise it may turn

out that huge capital investments may be frozen by the start of the 21st century in unnecessary mining, blast furnace and coke-chemical productions.

Criteria of Quality

Technical-economic indicators of ferrous metallurgy operation do not reflect fully the national economic effect of raising the quality and expanding the assortment of products.

In satisfying more fully the requirements of the technical progress of metal-consuming industries, ferrous metallurgy, by raising the quality of its output, creates a base for saving metal in machine building, metal-working and construction. The industry spends huge capital investments for raising the quality of the output, while the economic effect is realized almost entirely by the consumers. One of the reasons for this situation is that the quality of the metal output is measured by indirect technological data incommensurable with national economic efficiency.

The over 3000 existing documents on standardization on ferrous metals lack national economic criteria of quality such as: reliability coefficients, life, wear resistance, good machining properties, long time strength at high temperatures, etc. Instead of that, various technologies of production are widely represented such as: production methods, chemical composition, condition of delivery (with or without thermal treatment), methods of refining the metal, and monitoring these indicators. As a result, the consumer is unable to utilize properly the higher quality of the metal products in his machines and structures without preliminary testing. Five to 6 years pass until the consumer is able to evaluate realistically the quality of the ferrous metals. Several more years pass until the USSR Gosplan, the USSR Gossnab and the consumer ministries can reflect realistically this quality in their calculations.

Due to a lack of accounting of qualities consumers want in metal products in standardization documents, large expenditures directed to raising the quality of ferrous metals are not replaced by the effect obtained by consumers and in the national economy as a whole. The repayment of capital investments in raising the quality is extremely low. Wholesale prices for higher quality metal should be set taking into account the economic effect obtained by the consumer from using more efficient types of ferrous metals. The cost of a unit of consumer properties should not be raised; on the contrary, it should be constantly lowered.

Reserves of the Economic System

Thus, as a result of the effects of objective, as well as subjective factors, the efficiency of ferrous metallurgy development decreases. The matter should be set in such a manner that subjective factors would overcome unfavorable objective factors and the rise in the efficiency of production.

Further increase in the efficiency of ferrous metallurgy production (as well as of other industries of the national economy) depends to a great extent on improving the system of planning. Efficiency of the development of this or another industry is not being planned at present. Plans fix and record the high or low efficiency of the development of an industry, but do not set goals for raising it. In this connection, managers of union industrial associations and plants explain only the reasons for changing these or other economic indicators blaming objective and subjective factors, but do not raise them. The lack in the plans of goals for raising efficiency makes it impossible for managers of ministries, all-union production associations and enterprises to attain from their subordinates the achievement of these goals because all efforts are directed to the fulfillment of those indicators which characterize only indirectly the efficiency of operation.

It is possible to propose the following alternative planning efficiency indicators in ferrous metallurgy, as well as in other industries:

volume of profit in the industry, which it is necessary to obtain for providing the planned volume of national income;

rise in the profitability with respect to fixed production capital;

reduction in cost of production;

increase in output-capital ratio;

higher rise in profit as compared to the rise in fixed production capital;

rise in profit as compared to wages.

The introduction of one of the efficiency indicators into the plan must radically change the functions and trends in the operation of the technical and economic services of ministries, all-union production associations and enterprises. Economic services will define the basic technical-economic indicators of the operation of individual shops, facilities and equipment which provide for achieving the efficiency goals. Such indicators include norms for the consumption of raw and other materials, fuel, electric power, productivity of labor, maximum norms for amortization deductions, and the optimal assortment of metal products necessary to satisfy the requirements of the national economy. Technical services should be made responsible for the introduction of the most efficient technology, the organization of production and other technical measures for achieving the indicated norms.

The efficient utilization of raw and other materials and fuel in ferrous metallurgy urgently requires the development and introduction of automated systems for measuring, weighing, recording and warehousing raw and other materials, semifinished products and finished products.

In achieving the goals for raising efficiency in the industry, surplus profit should be directed to increasing production and raising wages in the industry. Moreover, the surplus profit may be directed to modernization or new construction. The USSR Gosplan need not interfere in the redistribution of profits between all-union production associations and enterprises.

Raising the efficiency of production requires the carrying out of a number of organizational-technical measures. We will note several of them:

1. Raising the role of wages and of the bonus system in stimulating the growth of efficient production. For this purpose, it is necessary to tie the rate of growth of wages not only to the output in kind or plan fulfillment in volume indicators, but also to fulfillment of economic indicators. The criterion for raising wages should be higher productivity of labor measured not by gross output, but by taking into account the higher profit per worker.

2. Determining the limits of expenditures and new capital investments. This is a logical consequence of determining the economic efficiency of any enterprise and new project. Limits of capital investments must be prepared on the basis of utilizing the experience of advanced enterprises and of the most efficient economic projects for individual production facilities being built and functioning in various territorial zones of the country, as well as taking into account their age and the conditions of material-equipment supply.

To prepare limits for current expenditures, it is necessary to introduce widely the parametric-norm method for calculating the metal output.

3. Hold contests for themost efficient design of new enterprises that provide not only the maximum achievement of technical progress and organization of production, but also the best indicators for increasing the efficiency of ferrous metallurgy production. The efficiency of the new plans should be compared to the efficiency of existing enterprises.

4. Improve the methodological rules for calculating the efficiency of production that reflect more correctly the utilization of fixed capital, amortization deductions, output-capital ratio and payments for fixed capital. At present, these indicators are calculated with respect to the cost of fixed capital in the initial evaluation without taking into account the amortization of this fixed capital and its residual cost. In order to evaluate existing and new production capital properly, it is proposed to correct thevolume of capital investments by the volume of amortization used for renovation, and evaluate fixed capital taking into account its physical wear and the accumulated amortization deductions transferred to the budget.

5. Improve the system of standardization and price formation to reflect more fully, in standards and prices, consumer requirements of ferrous metal properties and the efficiency of their utilization by consumers. Wholesale prices for new types of metal products must be established taking into account the part of the economic effect obtained by consumers.

It is proposed to show, in the standards, indicators of the operational characteristics of the metal as follows: units of strength, life, cold-resistance, transit capacity of pipes, carrying capacity of rails, corrosion resistance in various aggressive media, long time strength at high temperature, life of tires, etc. On this basis, it is necessary to create a system of additional payments taking into account the economic effect obtained from higher consumer properties of the products, but in such a manner that the cost per unit of consumer properties has a downward trend. Such a system will insure raising the efficiency of production and consumption of ferrous metals.

To load the facilities more fully with minimum expenditures at each metallurgical facility, it is necessary to develop a system of measures on improving the specialization of the metallurgical equipment and the combination and cooperation of production.

Reply of the Minchermet

In connection with the publication of a series of articles on urgent problems in developing ferrous metallurgy, the editor received a letter signed by Comrade S. N. Belorusov, deputy chief of the Technical Administration of the USSR Ministry of Ferrous Metallurgy.

The letter notes the considerable successes in the industry during the last 10 years: scales of production increased and its technical base improved on the basis of achievements of science and engineering. New, still more responsible problems are concerned with the necessity of raising the efficiency of production and the quality of the products. To solve them, it is necessary to raise the scientific level of planning and forecasting the basic trends in the development of ferrous metallurgy.

Many of the questions raised in the "EKO" journal (in particular, by comrades A. I. Tselikov, I. G. Pashko, A. A. Vertman, Ye. S. Kalinnikov, A. N. Glazov and E. B. Golland) were reflected in the preparation of the Tenth Five-Year Plan, as well as in the preparation of forecasts for the development of the industry up to 1990.

Academician A. I. Tselikov ("EKO," 1976, No 3) stressed the expediency of raising the unit capacity of metallurgical plants as follows: blast furnaces to over 5000m^3, converters to over 300 tons, electric arc furnaces to 200 tons and more, wide-strip mills to a productivity of about 10 million tons, etc. This path was followed by the reequipment of the industry in the past five-year plan period. It will continue in the Tenth Five-Year Plan period: it is planned to build a 5500m^3 blast furnace at the Cherepovetskiy

Metallurgical Plant, a 400 ton converter at the "Azovstal'" Plant, and construction is being completed of two wide-strip mills with an annual productivity of 6 million tons each at the Cherepovetskiy and Lipetskiy plants. In 1976-1980, it is proposed to increase the average useful volume of blast furnaces by 20 percent; converters -- by 30 percent; electric furnaces -- by 40 percent; the capacity of sheet-rolling mills -- by 30 percent; and structural rolled stock mills -- by 20 percent.

The ministry supports proposals by A. I. Tselikov on the necessity of taking into account combining the plants into a single production complex. The complexity of solving this problem is explained, probably, by the lack of the necessary scientific substantiation for building 8000m^3 blast furnaces and 400 ton electric arc furnaces.

In the Tenth Five-Year Plan period, there will be built in the USSR the largest high quality steel plant in the world based on using direct reduction iron. In the future, metallurgy without using coke will develop in the Urals (Orsko-Khalilovskiy Metallurgical Combine) and in Eastern Siberia (Kansko-Achinskiy Industrial Complex). Beside the Midreks process, domestic technological arrangements for direct reduction of iron will be used.

Further in the letter are mentioned the difficulties of realizing the process of fluidized slag bed (KShS) on a production scale. The process was tested in an experimental 10-ton reflecting furnace. The complexity of carrying on the process in a stable manner and the necessity of desulfuration outside of the furnace, due to the high content of sulfur in the product, were observed. The shortcomings of the KShS processes also include high consumption of power resources, high capital investments and great use of refractory materials. Investigations are being continued both here and abroad on developing a continuous process for producing steel without using coke metallurgy which must be more efficient and better than the KShS process.

The Minchermet agrees with suggestions by academician A. I. Tselikov on raising the efficiency of scrap preparation for metallurgical utilization (shredding units, cryogenic processing, smelting scrap in special furnaces, etc.). Regrettably, problems of gathering and preparing scrap countrywide are being solved slowly which, for a relative reduction in the yield of reusable scrap in metallurgy, delays an increase in the efficiency of ferrous metals production.

The conclusions and recommendations, formulated in the article by A. A. Vertman, A. N. Glazov and Ye. S. Kalinnikov ("EKO," 1974, No 4), raise objections. The basic conditions for building metallurgical mini-plants in Eastern Siberia and the Far East is considered by the authors of the article to be the lack there of a sufficiently developed RR network and other all-weather highways, capable of providing the supply of a considerable amount of raw materials and the exporting of the output, as well as

lack of large deposits of rich iron ore. They claimed the possibility of creating a line of plants with references to the experience of the United States, Italy and the FRG. This approach to the substantiation of a serious economic problem is evaluated in the Minchermet reply as unconvincing.

In the second article "Ferrous metallurgy, alternatives of development" ("EKO," 1976, No 3) A. A. Vertman and Ye. S. Kalinnikov, beside the problem of creating miniplants, touch also on other questions. Thus, noting the considerable time needed for assimilating technical novelties in ferrous metallurgy, they conclude that one of the reasons for this is the under-evaluation of the role and the insufficient development of fundamental research in the physio-chemical processes of smelting and steel working in all its conversions, as well as the small amount of attention given to scientific research in the USSR Minchermet system.

The Technical Administration of the Minchermet does not agree with this conclusion. Without successes in domestic metallurgical science, to the development of which our country has always devoted and is devoting attention, the USSR ferrous metallurgy could not have occupied an advanced position in the world. The letter cites the fruitful activity of scientists of such large scientific centers as the TsNIIchermet [Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin], Imet [Institute of Metallurgy imeni A. A. Baykov], IChM [expansion unknown], ChelyabNIIM [Chelaybinsk Scientific Research Institute of Metallurgy], Ural NIIChM [Ural Scientific Research Institute of Ferrous Metallurgy], UkrNIIMet [Ukrainian Scientific Research Institute of Metallurgy], UkrNIIspetsstal' [expansion unknown], DonNIIchermet [Donetsk Scientific Research Institute of Ferrous Metallurgy], Gipromez [State All-Union Institute for the Planning of Metallurgical Plants], VNIIOchermet [All-Union Scientific Research Institute for the Organization of Production and Labor in Ferrous Metallurgy], Stal'proyekt [State All-Union Institute for the Planning of Units for Steel Foundry and Rolling Mill Production in Ferrous Metallurgy, VNIIMT [All-Union Scientific Research Institute of Heat Engineering in Metallurgy] and many others. A great amount of research is being done by laboratories of metallurgical plants, and by laboratories of the MISiS [expansion unknown], the DMeti [Dnepropetrovsk Metallurgical Institute], the UPI [Ural Polytechnical Institute imeni S. M. Kirov] and other institutes of higher learning. The cooperation between specialists of the USSR Minchermet and the scientists of the VNIIMetmash [All-Union Scientific Research, Planning and Design Institute of Metallurgical Machinery], the Institute imeni Ye. O. Paton and many other research organizations of various departments is well known.

The letter argues the thesis that in modern metallurgical production, including four conversions, the possibilities of intensifying production and improving technical-economic indicators are limited. In rebuttal, reference is made to huge reserves for raising the efficiency of ferrous metals production cited in articles by comrades A. I. Tselikov and I. G. Pashko.

Great attention is given in the latter to ecological questions. Measures taken in the industry on reducing harmful exhausts, purifying air and water basins, reclamation of ground, etc. were pointed out. While in 1966-1970, 0.3 billion rubles were spent for these purposes and 0.8 billion rubles in 1971-1975, in 1976-1980, it is planned to spend over 1.4 billion rubles. These measures have already reduced environmental pollution in such large metallurgical centers as Magnitogorsk, Cherepovets, etc. On this basis, the thesis is questioned on the impossibility of further concentration and intensification of steel production using the present technology without disturbing the ecological balance in nature.

An article by I. G. Pashko, chief specialist of the USSR Gosplan ("EKO," 1976, No 3) is important to the ferrous metallurgy problem. Raising the quality of the metal products was considered the main problem of the Tenth Five-Year Plan. According to calculations, due to the improvement in the quality of metal and the expansion of the assortment of the products, 5 million tons of metal will be saved in the national economy in 1980. The organization of production is planned of 500 new efficient brands of steel and over 500 hot-rolled and cold-bent profiles. The production of the following types of products will be increased at advanced rates: low-alloy and thermally-hardened rolled stock, metal with protective coatings, cold-rolled and calibration rolled stock, etc.

Raising the quality of metal is an interindustrial problem which must be solved jointly by metallurgy and metal consuming industries. Due to an insufficient technological preparation of machine building to change over to pressing, stamping and welding of rolled sheet stock, the demand for castings and structural rolled stock still remains high. Therefore, the ratio of cast iron and structural rolled stock in ferrous metallurgy must remain high. On the other hand, domestic metallurgical machine building cannot provide the industry fully with the units necessary for essentially higher quality of metal products and modern press and welding equipment to machine builders. Therefore, the optimization of the structure of production and consumption of metal products in the next 15 to 20 years will be of great importance in reducing the metal-intensiveness of the national economy.

Concerning the article by E. B. Golland ("EKO," 1974, No 4), Minchermets' letter states that it correctly notes the successes of ferrous metallurgy, outlines the basic trends of its further development and stresses the necessity of raising the efficiency of ferrous metals production. This letter also makes individual aspects and factual data more precise.

For example, the article states that the need for solid rolled shapes, including bars and wires, is about 1 ton per 2 tons of flat rolled stock. The study of rolled stock requirements made by the USSR Gosplan with the participation of the main scientific research institutes of ministries and departments led to different conclusions.

A simple comparison of the number of shapes and shape-sizes of rolled stock in the USSR and in the United States does not tell anything about the assortment of metal products because in the USSR the assortment is constantly being renewed while foreign catalogs show shapes which have been out of production for a long time. The assortment of solid rolled shapes cannot be judged by the amount of chips because it depends on the relationship between volumes of metals working on turning machine tools, forging-pressing and welding equipment.

An attempt to determine the economic effect of a possible increase in the scale of production in accordance with progressive technical solutions in 1960-1975 has an abstract nature, because it does not take into account the limited capital investments, the realistic conditions for their assimilation, the necessity for allotting money for providing the volumes of production, the need of the national economy has for the considered types of ferrous metals and the technical possibilities.

From the Editor

The journal thanks the Technical Administration of the USSR Ministry of Ferrous Metallurgy for its interest in published materials. The editor intends to continue the discussion of urgent problems in the development of the industry. As before, it is proposed to concentrate the main attention on problems of quality and efficiency.

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OPERATION OF THE KURSK MAGNETIC ANOMALY

Moscow TEKHNIKA I NAUKA in Russian No 5, 1977 pp 2-5

[Article by A. Sonkin, engineer]

[Text] In the very center of Russia, on an area that occupies less than one hundredth of our country, is concentrated over one third of its iron reserves. "...We have here riches almost truly unseen in the world which are capable of upsetting the entire metallurgical business," -- wrote V. I. Lenin.

The Kursk Magnetic Anomaly [KMA] spans the territory of the Kurskaya, Orlovskaya, Belgorodskaya, Bryanskaya, Khar'kovskaya, Donetskaya, Sumskaya, Voronezhskaya, Luganskaya and Rostovskaya oblasts and covers an area of 160,000 km^2.

The deposits of iron ores stretch from southeast to northwest for a distance of 850 km. They are 40 to 250 km wide.

The estimated reserves of rich iron ores of the KMA are 40 billion tons and of iron-quartzites -- practically inexhaustible. This is the largest and richest iron ore region in the world.

The explored reserves of minerals in the KMA increase every year. New levels and deposits are being put in operation. The volume of ore mining here is doubled every 5 years. At present, because of a lack of local metallurgical facilities, commercial ore of the KMA is transported to various plants beyond its boundaries. Of course, it would be considerably more profitable to utilize the ore near the place of its mining. The Tenth Five-Year Plan will introduce an essential and favorable change in this situation; the largest electrometallurgical combine in the world will be built in the region of the Staryy Oskol.

The output of the Oskol giant -- steel without harmful admixtures and rolled stock with high mechanical properties -- is being awaited impatiently by machine builders. Experience in building the combine is needed by the metallurgists themselves because the firstborn of metallurgy without using coke (or without blast furnaces) is being built here at Staryy Oskol.

The technological chain will start at the Lebedinskiy Mining-Enriching Combine. Super-concentrate will travel from here over a 27-kilometer sludge line to the pelletizing factory. Further, the oxidized pellets will be sent to a shaft furnace where they are almost completely rid of oxygen with the aid of natural gas. Metallized pellets with a 90 to 95 percent iron content will enter electrical furnaces in a continuous stream. We stress -- continuous. This is one of the main advantages of the process because all conversions can be tied into a single automated line. Neither coke, nor expensive blast furnaces will be required.

The full rated capacity of the Oskol'skiy Electrometallurgical Combine is designed for an annual output of 7 million tons of oxidized pellets; 5 million tons of metallized pellets; 3.5 million tons of steel and 2.7 million tons of rolled stock.

Enterprises will produce up to 6000 type-sizes of high precision profiles. For comparison -- at present the domestic list of rolled stock products has about 4000 type-sizes.

In 1976-1980, in the new city for metallurgists there will be built housing with an area of 1,350,000 m^3, schools for 13,000 students, kindergartens and nurseries for 8400 children and hospitals for 1600 beds.

The appearance in the very center of Russia of a new Magnitka will change the face of Staryy Oskol unbelievably and will put it in population, size and comfort in the ranks of large cities of oblast importance. The city is already being prepared to be raised to the "higher rank." Construction is being completed of a peripheral road which will eliminate heavy truck traffic through the city and will shorten the distance between the bases and the combine by 10 km. A 142-meter bridge is being built across the Oskol River.

A 25-kilometer road bed is being poured for a high speed, first class motor vehicle highway between the new city and the combine. The route of a high speed street car will be parallel to it. Its comfortable cars will carry up to 400 passengers per trip. People will be able to get to work from the new city in less than half an hour.

The very name of the combine -- "electrometallurgical" -- stresses that electric power will be one of the main means for obtaining metal here. Powerful electric power transmission lines are being built to provide this power starting at the Kursk and Voronezh AES in the Dneproenergo system. There will also be new rivers -- it is proposed to build the Oka-Don-Oskol canal 200 kilometers long. A 100-kilometer gas line will provide the KMA with blue fuel.

Not only do visible threads tie Staryy Oskol to the entire country now, from Siberia and Kazakhstan, from the Ukraine and the Urals people come here and write letters: "I want to work in the new combine," "I want

to build the city of the metallurgists," "I want to participate in the formation of the KMA Territorial-Production Complex." Over 5000 letters of this kind, which were accumulated in the directory of the combine under construction, are a testimony of the peculiar "magnetic" attraction of the Kursk basin.

Capital investments in the KMA industrial complex will be about 5 billion rubles in 1976-1980. This is almost half a billion rubles more than in the past five-year plan period.

The 15-year program for developing the KMA complex specifies an increase in the volume of production of electric power by 17.5 times, ferrous metallurgy -- 5.7 times, machine building -- 4.1 times, and construction materials industry -- 2.4 times.

The largest industrial construction projects at the KMA in the very near future, besides the Oskol'skiy Electrometallurgical Combine, will be the Yakovlevskiy Deposit for the underground mining of rich ores, the Stoylenskiy Mining-Enriching Combine (GOK), the second and third stages of the Lebedinskiy GOK, the plant for repairing mining equipment, and the plant for agricultural machine building.

Great, sometimes unexpected problems arise also for scientific organizations which work directly on problems of the KMA. All of them, in the final result, reduce to the comprehensive assimilation and development of the basin. Concrete targets for the KMA are included in the five-year plan of 30 institutes subordinated to seven ministries. The scientific research work will be coordinated by the Scientific Research Institute of the Problems of the Kursk Magnetic Anomaly (NIIKMA).

Ore, as is well known, is mined by two methods -- underground (shafts) and strip mining (open-cuts). The collective of the local institute is working on improving the equipment and technology used in both methods. We will not enumerate the numerous innovations born as a result of direct contact between scientists and production collectives. We will only say that these collectives themselves originated due to objective developments by the scientists. In particular, as a result of economic and technological substantiations carried out by the NIIKMA and as a result of its direct participation in planning, construction and adjustment of equipment, there arose in the past five-year plan period a giant of ferrous metallurgy -- the Lebedinskiy GOK.

During the Ninth Five-Year Plan period, the NIIKMA collective introduced into production the results of research work on 98 tasks. The annual economic effect was 13 million rubles.

The planning institutes of the USSR Minchermet [Ministry of Ferrous Metallurgy] used the results of 136 developments of the NIIKMA. The economic effect was over 43 million rubles.

The yield per ruble invested in science for the KMA averaged 6.8 rubles.

The introduction of developments by scientists made it possible for the KMAruda Combine collective to free 530 persons and raise the productivity of labor by 31.6 percent during the five-year plan alone.

The first stage of investigations on the comprehensive assimilation of the natural resources of the KMA and the preservation of the environment has already been completed. Technical-economic substantiation was prepared for the reclamation of ground destroyed by strip mining. Moreover, the KMAruda Combine transferred over 130 hectares entirely suitable for crops and planting forests to agriculture.

Along with the solution of mining problems especially, local scientists also work on economic-organizational problems on which the rate of technical progress at the KMA depends to a considerable extent. We will dwell on one of these problems in somewhat greater detail.

The primary reserves of iron ore in the basin are concentrated at seven of the most explored deposits: the Lebedinskoye, Stoylenskoye, Chernyanskoye, Pogrometskoye, Yakovlevskoye, Gostishchevskoye and Mikhaylovskoye. Historically, it came about that mining-enriching combines were planned and built on the deposit-enterprise principle. Up to the present GOK at the KMA function separately. Although the distance between deposits is frequently only 6 to 8 km, each combine has its drilling-blasting complex, its transport facilities, an autonomous computer center and its own repair base. This organization makes it impossible to utilize fully scarce equipment for related technological processes. The only way out of this situation is concentration of production that would eliminate these kinds of problems.

Investigations carried out by the NIIKMA jointly with the Moscow Mining Institute showed that strip mining of, say, the Starooskol'skaya group of deposits should be done as a single giant strip mining operation. The creation of such a superpowerful enterprise with comprehensive mining of 160 to 200 million tons of iron quartzites, 15 million tons of rich ores, 4 million m^3 of crushed stone, 12 to 18 million m^3 of structural and glass sand, 25 to 40 million m^3 of small marl rocks will make it possible to free up to 15 percent of the industrial-production personnel and more than double the output of commercial ore from the same areas.

It is obvious that such plans cannot be realized by mechanically combining the existing production facilities. In addition to thoroughly thought-out structural and organizational changes and besides economically substantiated proposals for production proportions of the mining-enriching combine of the future, scientists and designers are expected to provide mining equipment new in principle and unique in scale and in possibilities.

Up to the present, ore in the basin has been extracted primarily by strip mining. The main mineral resources, however, are concentrated at a great depth. At the Yakovlevskoye deposit, for example, rich ore lies at a depth of 600 meters. The deposit layer here cannot always be drilled through. To reach the underground treasure by strip mining would require a pit 20 km wide at the top just to reach the body of ore. To work in the pit would require stripping many hundreds of hectares of fertile ground.

In such a situation, obviously, it is more expedient to mine the ore by the underground method. Thus, sooner or later, it will be necessary to build mine shafts at the KMA. This means that it is already necessary to think of tomorrow. Already it is necessary to accumulate experience of building mine shafts under complex hydrogeological conditions characteristic of the given region.

Three years ago, the leading drift miner brigade of the Shakhtospetsstroy Trust headed by L. Seryy was given in a solemn setting the symbolic key to the Yakovlevskoye underground treasure. Thus began the sinking of the first hole of the deepest and most powerful shaft in the world being built by the freezing method.

The full rated capacity of the Yakovlevskiy deposit will be 20 million tons of rich ore annually.

In the current five-year plan period, mine builders must drill hundreds of frozen, monitoring-measuring and holes for lowering the water level 600 to 650 meters deep, and dig cage, skip and ventilation shafts 12 meters in diameter each in the rough.

Reduced costs per ton of iron in the commercial ore of the Yakovlevskaya mine will be 16.3 rubles, while in the KMA enterprises being built these costs will vary from 17.3 to 21.1 rubles.

However, so far the KMA deposit is worked primarily by the open-cut method. Here is a broad field of activity for an inquisitive engineering-technical mind.

Until comparatively recently, deposits worked by strip mining were planned and built counting on rich ores containing, as in the Mikhaylovskoye deposit, 55 percent iron. Such ore can immediately after crushing, without enriching, be put in production. However, below the rich ores, as a rule, lie oxidized quartzites containing 40 percent iron. Still lower lie unoxidized quartzites. The reserves of these relatively poor ores are counted in trillions of tons. To mine poor ores it is necessary to widen the pit. Is this worth it?

The engineers of Mikhaylovskiy GOK proved jointly with scientists the economic effectiveness of expanding the boundaries of the open pit in order to work it at all levels. The substantiation proposed by the economists

served as a basis for developing and checking out technological arrangements for enriching oxidized quartzites. However, so far only the upper and lower layers of the ore deposits are being used. The oxidized quartzzites (middle layer), are dumped as before. The situation is that the existing arrangements for enriching are based on the magnetic method, while hematite -- the ferrous component of oxidized quartzites is, as is well-known, a weak magnetic mineral. What to do? The reserves of oxidized quartzites at the Mikhaylovskoye deposit alone are 2565 million tons. The combine mines and stores them in dumps every year and have already accumulated over 400 million tons of the valuable raw material. This is indeed a matter for thought.

The current five-year plan will put an end to this wastefulness. A new in principle method for enriching oxidized quartzites using a combination magnetic-flotation arrangement was checked under laboratory conditions and will soon be tested under industrial conditions. An experimental-industrial installation is being built for this purpose at the combine. Thus, in fighting for full, comprehensive utilization of raw materials, domestic industry is rising, if one may say so, to the third step. But this is not all. There also will be the fourth step.

At present, enrichers, regrettably, cannot extract all the iron from the quartzites. A considerable part of the iron goes into so-called tailings in the processing of the raw material. Another problem is to reduce losses and achieve full extraction of the minerals from rocks. This will also be solved in the current five-year plan period. The checking out of the technology for greater enrichment of tailings at the KMA, particularly at the Mikhaylovskiy GOK, is proceeding at full speed.

In 1976, the Mikhaylovskiy GOK processed 14.2 million tons of raw ore and obtained 5 million tons of concentrate with an iron content of 64.5 percent.

Involving oxidized quartzites in production will give the national economy an effect counted in billions of rubles.

The method of enriching tailings will increase the yield of iron from quartzites by 12 percent.

Let us now total up. The start of the second stage of the Mikhaylovskiy GOK will increase its capacity to 30 million tons per year. Finishing up the industrial technology of enriching oxidized quartzites will create premises for building another factory with a productivity of 30 million tons. To this should be added many million tons produced by the method of further enrichment of the tailings. And this involves not only one enterprise. It is truly large scale production!

From the Editor

Mining rich ores at the KMA basin is unavoidable and the sooner it is realized the more successfully will the basin develop. Regrettably, up to the present the solution of several problems related to the comprehensive utilization of the mineral resources of the KMA is being delayed by a number of objective and subjective causes. The construction of the Yakovlevskiy underground mine is proceeding extremely slowly. The intensity of research and planning-design work on creating mining equipment for it is insufficient.

The rate of construction and development of strip mining is also being slowed considerably by the lack of high efficiency ore-transporting equipment: excavators with large capacity buckets, high load capacity dump trucks, powerful bulldozers and other machines and devices. The ministries manufacturing such equipment, obviously, are not coping with the problems posed before them.

There is a departmental approach to the solution of a number of important problems. Thus, in the comprehensive assimilation of theVislovskoye iron-bauxite deposit, the USSR Minchermet and the USSR Mintsvetmet [Ministry of Nonferrous Metallurgy] are interested. They cannot agree up to this time under what conditions to start the assimilation of this deposit.

For many years, attempts are being made to solve the problem of utilizing the ores and the overburden in various ways and at various levels. In this, it would seem that the USSR Minchermet and the USSR Minpromstroymaterialy [Ministry of Industrial Construction Materials] should be primarily interested. However, the first ministry is allotted money for the organization of reprocessing extracted byproducts, while the second ministry prefers to have small enterprises for mining the raw materials and not become involved in obtaining them from the KMA enterprises.

Obviously, to accelerate the positive solution of the problems, it is necessary that such organizations as the USSR Gosplan and the USSR Gosstroy be involved.

In the process of mining magnetite quartzites, a great amount of other oxides are obtained which are potential raw materials for obtaining high quality iron concentrates. However, the problem as a whole of their enrichment has still not been solved completely. The resulting losses are great. It is, therefore, necessary to force scientific and experimental-industrial work in this area.

Still another problem has not been solved to a sufficient degree. The development and concentration of production in the KMA region involves the pollution of the environment. Scientific research work in this area is still behind today's requirements. There is still not enough equipment for reducing harmful exhausts. This is also true of reclamation of the ground destroyed by mining.

It is also necessary to accelerate the solution of the problem of developing, in the basin, light and local industries for providing work to those people who for some reason cannot participate in basic production. This problem can be solved by the SOPS [Council for the Study of Productive Resources] at the USSR Gosplan.

There are many problems tied in with the comprehensive utilization of the KMA resources. The editor invites all interested ministries, departments, establishments and all our readers to discuss ways for their solution seriously.

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CSO: 1822

SIBERIAN RIVER REVERSAL AND ITS ECONOMIC AND ECOLOGICAL IMPACT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 16 Jul 77 p 3

[Article by A. Yanshin, academician; V. Saks, corresponding member of the USSR Academy of Science, Novosibirsk: "Where Do the Siberian Rivers Flow?"]

[Text] G. Semenov, a Volgograd engineer writes: "I read with great satisfaction the constitution plan stating that 'the citizens of the USSR are obliged to protect nature and to conserve its riches.' Such an approach must outline the expediency of every major action involved in the economic turnover of land and mineral resources, the forests and water. But do not such grand schemes such as the reversal of Siberian rivers, which SOTSIALISTICHESKAYA INDUSTRIYA has told about at one time, contradict the ecological norms that have taken form over the centuries?"

The scientists respond:

After publication of the article "The Rivers Flow Back," we received many letters from readers. Some ask for more in depth explanations of the problems attached to the transfer of a portion of the effluents from Siberian rivers into the limited water regions of Central Asia. Others fear this transfer will bring harm rather than be beneficial, while still others offer their own versions for solving the problem. The letters are diverse but have a common thread. Their authors not only well understand, but have the difficult problems close to their hearts of man's interrelationship with his environment. How shall we respond to these questions?

The problem of transferring a portion of the effluents of the Siberian rivers into Central Asia is diverse in its enormity. To achieve this the establishment of the necessary canals, pumping stations, pipelines and reservoirs with full utilization might be called the construction project of the century. But in the meantime we do not speak of construction. In accordance with the decisions of the 25th CPSU Congress, the 10th Five-Year Plan has been fully devoted to scientific research which must prepare the base for drawing up the most efficient plan. This does not exclude the possibility that complex scientific research in general will show that it is inadvisable to force the beginning of construction. However, there can be no doubt that

if not in the 80's, then no later than by the end of the present or beginning of the next century, the water of the Siberian rivers will to some degree be used to create flowering gardens and cotton fields in the arid regions of Central Asia.

Even at present the institutes of the Siberian branch of the USSR Academy of Science [AN SSSR] are carrying out physico-geographic, geological, botanical and zoological investigations in the zone of the forthcoming water transfer. Under study is the structure of the near surface layers of rock in which future routes might be placed. Underground water, plant cover and the makeup of the soil are being researched. Great attention is being devoted also to the problem of land reclamation of the southern regions of Western Siberia. Failure to account for this would make it impossible to plan the transfer of water of the Siberian rivers into Central Asia.

Generally speaking, in order to thoroughly substantiate the plan, it is necessary to develop research in the most diverse fields of science. Of special importance is the study of the water balance of Siberia (including underground water) and possible changes to it in the future. What is needed is meticulous investigation of the natural environment in the water transfer zones. Without this it is impossible to forecast the probable changes of this environment. It is necessary to eliminate or keep to a minimum all undesirable and harmful consequences arising from water diversion, laying of canals and pipelines, and the establishing of reservoirs. For example, on the Karakum canal run a large amount of water from the Amu-Dar'ya is lost. It seeps into the sand before reaching the first irrigated fields. The transfer of Siberian water over significantly greater distances must be protected from such losses. And there is another danger. The decrease of effluents of warm river water into the Kara Sea and the appearance of large new reservoirs might impact substantially on the climate of both the southern agricultural regions of Western Siberia and on the Arctic seas. In order to accurately forecast the possible consequences of this there must be wide use of mathematical modeling methods.

Finally, we must not forget about economic efficiency for both the entire water transfer plan and for the specific measures within the framework of this plan. And here we also cannot limit our studies just to Siberia. One side of the scales shows the positive results where Siberian water is provided to Central Asia while on the other are the construction costs and the possible consequences from withdrawing a portion of the river drainage from Siberia.

Even this is far from a complete list of the problems but it shows how great the volume of work is that must be completed by science. It should be noted that research on these problems in Siberia is being done by, besides the Siberian Branch of the USSR Academy of Sciences [SO AN SSSR], many organizations of other departments, and a number of scientific-research and planning institutes situated in the European portion of the USSR. And, as Leningrad resident V. Shevchenko, one of our readers, correctly notes, under these

conditions coordination of all work is a matter of utmost importance. On a national scale the coordinating center is the State Committee on Science and Technology of the USSR Council of Ministers. Within the framework of the USSR Academy of Sciences is the Institute of Water Problems. In Siberia these functions must be carried out by the SO AN SSSR. Here a scientific council for the problems of water resources redistribution is being created in which workers of all departments conducting such research will be represented. But, of course, the efficiency of the work of the council would be greater if a scientific subdivision would be established which might directly work on the problem of transferring the Siberian water and which might actively influence the direction of work at other institutions.

And last, we would like to say something about the plans proposed by the readers themselves. Earlier it was stated that the solution of the problem is tied to the great volume of the most serious research in that the "apparent" alternatives under analysis turn out to be by no means optimal. Nevertheless, several of the readers' ideas are of interest. For example, I. Krasnyanskiy from Novokuznetsk proposes altogether not disturbing the basin of the Ob', but using the fully watered system of the Yenisey to provide water to Central Asia. His idea is to build a pipeline from the mouth of the Angara to the Aral Sea. The pipe would have a 25-meter diameter and extend about 2,600 km. I. Krasnyanskiy's ideas originate from two actual important circumstances. First, the Yenisey system is deeper than the Ob'-Irtysh system, and, second, the Yenisey's basin differs from that of the Ob' in that the water needs are not great for land reclamation. Therefore, the inclusion of Yenisey water in the redistribution system will apparently be required. However, the construction of a 25-meter pipeline from the mouth of the Angara up to the Aral Sea is such an immense undertaking that it would hardly be realizable in the coming decades. It is probably much simpler to feed the water from the Yenisey system into the Ob' using the old Ket'-Kasskiy Canal, and further on together with Ob' water through the lower reaches of the Irtysh and the Turgayskiy depression to the Aral Sea, or by-passing it from the east. Selection of a plan that is both optimal from an economic standpoint and from the standpoint of protecting the natural environment is precisely the task of those complex scientific studies that must be carried out during the 10th Five-Year Plan. So that there is no basis to the fears expressed by several readers, the very approach to developing this grandiose scheme fully responds to the regulations of the constitution's plan that is impregnated with deep concern about the protection of nature.

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