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Translation

TRANSLATIONS ON MAJOR USSR RIVER DIVERSION PROJECTS

Volume II

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TRANSLATIONS ON MAJOR USSR RIVER DIVERSION PROJECTS

VOLUME II

CONTENTS

PREFACE

This is the second of a four-volume special report. Most of the translations are reports or discussions on proposals for or ramifications of projects to divert part of the flow of certain major northward flowing river systems into areas of the southern USSR, especially Kazakhstan and Central Asia.

This collection of translations was prompted by a notable increase in the volume of material published about the feasibility of river diversion projects; most of this material was published just before and during the 26th CPSU Congress held in February 1981. The material selected is from a broad range of Soviet central and republic newspapers and journals, in the local languages of the Central Asian republics as well as in Russian.

STATEMENTS BY POLITICAL LEADERS

SIBERIAN RIVERS REDIRECTION LINKED TO FOOD PROGRAM

LD051215 Tashkent PRAVDA VOSTOKA in Russian 20 Dec 80 p 1

[UZTAG report: "Uzbekistan CP Central Committee Conference"]

[Text] A conference on the problems of redirecting part of the flow of the Siberian rivers into Central Asia and Kazakhstan took place at the Uzbekistan CP Central Committee 19 December.

A. N. Yeremenev, deputy chief engineer of the project at the Soyuzgiprovodkhoz Institute, gave the report on this issue. A. A. Borovoy, deputy chairman of the USSR Gosstroy; P. A. Poladzade, USSR first deputy minister of land reclamation and water resources; corresponding member of the USSR Academy of Sciences G. V. Voropayev, director of the Institute of Water Problems; A. Kh. Khodzhimuratov, Turkmen SSR Minister of land reclamation and water resources; I. Kh. Dzhurabekov, Uzbek SSR minister of land reclamation and water resources; N. R. Khamrayev, chief of the Glavsredazirsovkhozstroy Main Administration, and V. A. Dukhovnyy, director of the Central Asian Scientific Research Institute of Irrigation, participated in a discussion of this problem.

The participants in the conference noted the great significance of the problem under discussion for the further expansion of the country's national economy and the implementation of the food program. They supported the advisability of beginning preparatory work on redirecting part of the flow of the Siberian rivers into Central Asia and Kazakhstan in the 11th 5-Year Plan and continuing scientific and planning studies on the said question.

Sh. R. Rashidov, candidate member of the CPSU Central Committee Politburo and first secretary of the Uzbekistan CP Central Committee, spoke at the conference.

I. G. Anisimkin, L. I. Grekov, I. B. Usmankhodzhayev, A. A. Khodhayev and N. D. Khudayberdyyev, members of the Uzbekistan CP Central Committee Bureau, took part in the work of the conference.

CSO: 1829/233

ECONOMIC ASSESSMENTS

RIVER DIVERSION SEEN AS ONE ASPECT OF INTEGRATED SOCIOECONOMIC DEVELOPMENT

Tashkent KOMMUNIST UZBEKISTANA in Russian No 6, Jun 79 (signed to press 28 May 1979) pp 14-21

[Article by M. Abdusalyamov, candidate of economic sciences: "Issues of Inter-regional Cooperation and Integration of Central Asia, Kazakhstan and Siberia"]

[Excerpts] The rapid rate of economic development in the eastern regions is the result of the objective need for the utilization of their enormous natural resources and potential in the interests of the entire country. These regions have nearly 90 percent of the nation's total fuel and energy resources, about 80 percent of the forests, more than half of the predicted reserves of non-ferrous metal ores and of chemical and aluminum raw materials, a significant portion of the iron ore reserves, and the bulk of the raw materials for light industry, etc. National production on the necessary scale cannot be achieved without putting these resources into economic circulation.

At the same time the successful realization of the targets for the development of natural resources in the eastern regions is beginning to depend to an ever greater degree on the rational division of labor among these regions. It is becoming essential to have not only a differentiated approach to the problems of developing each region, but also improvements in their economic ties and a program for implementing close cooperation in production and integration primarily in Siberia, Central Asia and Kazakhstan.

A better way to develop the productive forces of these regions must be determined primarily by the interests which our entire nation has in the comprehensive development of these natural resources and in the expansion of the economic potential which exists here. For it is in these regions that the solutions will be found to the problems of realizing the major comprehensive programs of inter-sectorial and inter-regional significance, programs which go beyond the limits of our current century and which require enormous resources. To a significant degree this determines the basic trends in the development of the region's economy. The following may be included in these trends: the establishment of national fuel and energy bases; the formation of ferrous metallurgy and machine building bases; the development of the USSR's largest energy-intensive production units of the chemical and petrochemical industries and of non-ferrous metallurgy; the establishment of another food-producing area for the nation; and the diversion of some of the Siberian river flow into the basin of the Aral Sea.

Each of these problems requires for its realization the territory and resources of practically all of the eastern regions; for this reason it makes sense to examine them as a single object for planning and prediction and for the development of comprehensive programs. This kind of approach, while expanding the horizons for planning and aiming the plans at economic end results, will make it possible not only to solve in a comprehensive manner the complex problems of economic and scientific-technical cooperation among these regions but also to ensure temporal coordination in accordance with common interests and plans for the development of the nation's economy.

The soundness of this approach also derives from the fact that the present intensive growth in the economic potential of the eastern regions offers the most favorable opportunities to carry out here major economic programs and to conduct economic and technical experiments through the effective redistribution of capital investments in the various economic sectors and territories and through special purpose intersectorial and regional programs.

The inadequate level of development in the productive forces of the eastern regions and the differences in these forces as they exist in each of the regions also dictate the need for close cooperation in solving complex economic tasks and in coordinating long-range plans.

All of these questions are exceptionally timely for the republics of Central Asia, and for Uzbekistan in particular, because the situations which are developing in regard to supplies of certain types of natural resources, as well as demographic and economic conditions, puts these republics in a special position in the system of the eastern regions. It is important for Central Asia to have a comprehensive approach to the solution of water-supply and fuel-and-energy-supply problems, as well as the problem of how to make rational use of labor resources, inasmuch as these problems determine in the greatest measure the future trends in Central Asia's socioeconomic development. We shall examine the main premises of the most important of these for Central Asia.

Partial Diversion of Water from the Siberian Rivers into the Basin of the Aral Sea. In the economic literature and in scientific studies sufficient attention has been devoted to this problem, which is complex and grandiose in scale and which has no equal among similar problems which are being solved at the present time. It is worth focusing only on certain aspects of the problem.

It has already been shown that without diverting some of the water from Siberian rivers into the basin of the Aral Sea there will be no possibility of accelerated development for the economy of Central Asia in the near future. The effective utilization of agricultural lands in a significant portion of Siberia and Kazakhstan also depends very closely on the implementation of this program. At the present time the shortfalls of agricultural products in bad years are reaching significant amounts in those regions of Kazakhstan which are most subject to drought and in the Kulundinskaya and Barabinskaya steppes.

Diversion of Siberian water will make it possible to use more effectively the irrigation area and to develop about 20 million more hectares in Central Asia and Siberia; it will also solve a global problem by creating a major new food-producing area in the nation's East. The southern part of Western Siberia, Kazakhstan and Central Asia (Uzbekistan) have the most favorable conditions for the siting of grain farms in comparison with all the possible zones for growing these crops. The water of Siberia will ensure a sharp increase in the production of cotton, which will be grown on a scale to completely satisfy the nation's needs; with this water there will be in this area another source of an enormous amount of high-quality wheat, as well as one of the world's largest bases for the production of grain.

The realization of the plan to divert the waters of Siberian rivers is also related to the construction of a new water-transportation artery, which will use a system of deep-water canals to connect the Ob' and the Irtysh with the Syrdar'ya and the Amudar'ya; this artery will carry a significant amount of the freight moved between Siberia, Kazakhstan and Central Asia.

A final result of the diversion of Siberian rivers will be the organization of a major new meridional zone for economic development in the Asian USSR and the emergence of major new industrial centers here. This will lead to substantial changes in the industrial structure of the economy in the eastern regions; it will provide a powerful new stimulus to the productive forces of the nation, and it will increase the role of the USSR in the world economy.

Central Asia has at its disposal significant resources of hydrocarbon raw materials, and this creates favorable conditions for the development here of a number of petrochemical production units such as plants to produce synthetic resins and artificial fibers, plastics, rubber, etc. However, this process is moderated and in the future will be limited by a shortage of water and electrical energy resources, as well as by a lack of free land areas which are essential for siting the appropriate enterprises.

Before the problem of diverting part of the Siberian river flow is solved, the petrochemical industry of Central Asia could be oriented to a certain degree toward the processing of the most energy-intensive and water-intensive intermediate products--obtained from Siberia--into end products. And, in turn, this form of cooperation would make it possible to develop at an accelerated rate a complex of production units for the electrotechnical and construction industries, as well as to increase the output of machine parts, thermal insulation and finishing materials, sanitary engineering equipment and consumer goods.

The economic ties between the two regions may find the fullest form of their expression in reciprocal deliveries of agricultural products, in the establishment of a distinctive "green bridge" between Central Asia and Siberia.

Due to natural conditions the demands of the Siberian population for melons, grapes and other fruits, as well as much of the demand for vegetables, must be satisfied by other regions. Calculations show that by late 1980 it will be necessary to bring in up to 1.1 million tons of vegetables and melons, up to 1.6 million tons of grapes, fruits and berries, and by the end of the following decade it will be necessary to bring in 1.5 million tons and 2.6 million tons respectively.

In the meantime Central Asia does not contribute a large proportion of the fresh fruit and vegetable supplies which Siberia receives. However, the Central Asian republics must remain the nation's major producers of cotton, but they must also become the most significant base for the production of vegetables, melons, berries and other fruits in the East and the major supplier for the various parts of Siberia.

In turn Sibera can become a major supplier of its products to Central Asia. Calculations show that in the near future it will be in a position to meet all of Central Asia's demands for milk products, potatoes, and most of its demand for grain fodder. Siberia has immeasurably greater opportunities for this than does Central Asia. Deliveries of meat and meat products can grow substantially, as can deliveries of the "gifts" of the taiga--mushrooms and various forest fruits.

In order to resolve all these issues it is necessary to link more closely the prospects for the development of production and for consumption of food products in both regions. Specifically, this will make it possible to utilize more effectively the advantages of the agroindustrial complexes which are being established in both areas. We have in mind the expansion of the "green bridge" as a result of the implementation of a comprehensive special-purpose program to integrate development (the "green bridge" can function to an equal degree in both directions--with approximately 2 million tons of products per year). This program could serve as the foundation for the transition to the next stage--the development and realization of a comprehensive, special-purpose program to establish a single food base for the eastern regions of the country.

The problems which have been examined here constitute only a part of the broad range of issues in the long-range planning and prediction process for the development of the economy in these regions. However, it is clear that our interest in increasing the effective utilization of their resources makes it necessary to have close coordination in the process of formulating plans for the accelerated growth of the production forces here; this coordination would be based on principles of economic integration and would arise from the general strategy for increasing the economic potential of the nation's eastern regions.

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SIBERIA-CENTRAL ASIA CANAL DESCRIBED

Tashkent EKONOMIKA I ZHIZN' in Russian No 3, Mar 80 pp 52-54

[Article by U. Bogdalov: "Northern Waters Will Help the South"]

[Text] When we peer at our planet from outer space, land is the least that we see. From earth orbit, the great continents look like islands in the ocean. So the cosmonauts say. It is no accident that life itself came into being in water. And it cannot continue without water. Enormous masses of water are cycled on earth. But the bulk of the moisture that evaporates into the atmosphere returns to the bitter, salty ocean. Of the amount that falls on land, only about 13 percent is used by plants. All plants--both wild and cultivated. And only part of their biomass serves as food for animals and people.

Plants used 13 percent in the time of human society's inception. And they still use the same amount today, when there are several billion of us on earth. Thinking about this increase in plant productivity, the first thing that comes to our mind is the water these plants need.

The shortage of water--the basis of life--is growing ever-larger. In some areas of the USA the price of water is rising as quickly as the price of gasoline or food. A number of countries are thinking about towing Antarctic icebergs--giant reservoirs of fresh water. Man is concerned with altering the flow of water on the continents, and with development of irrigation systems. The scale of his activities in this direction is enormous. Scientists estimate that the area of the world covered by manmade seas and lakes is now close to 400,000 square kilometers. For comparison we can recall that the area of the Black Sea is 420,300 square kilometers. In just the last quarter of a century the number of reservoirs on the globe has tripled. Concurrently with redistributing fresh water, man has also started producing it in huge desalinization facilities.

It would seem that in our country, with its inexhaustible water resources, there need not be any special concern about the future. There are more than 3 million rivers, streams, canals, creeks, and intermittent water channels in the USSR. Their annual discharge is 4,700 cubic kilometers. This is more than enough to satisfy all future demands. Judge for yourself--in 1960 the USSR's total water consumption was 150 cubic kilometers. In 1975 it was 315 cubic kilometers.

But this does not make the water supply problem any less acute. Distributing our water reserves, nature did so without regard to the future demands of an enormous country. It limited their presence precisely where they are needed the most--in the southern reaches of the European USSR, in the Central Asian republics, and in Kazakhstan. These regions use more than 80 percent of the water resources. Moreover agriculture has been and continues to be the main user of moisture. Almost half of the regularly irrigated land, on which 95 percent of the cotton, 40 percent of the rice, and 25 percent of the vegetables and melon crop are grown, are concentrated in Central Asia and Kazakhstan.

Good land, generous sunshine, and abundant manpower are making it possible to dramatically increase the wealth being produced today. Thousands upon thousands of hectares are awaiting water in Uzbekistan's Karshinskaya, Dzhizakskaya, and Sherabadskaya steppes. But already today, there is not enough. Especially in low-water years. Despite the great efforts to redistribute discharges and accumulate moisture in reservoirs, we are feeling the water shortage more acutely with every year. By the end of the century the demand for it will increase by half again as much in the Aral basin.

Recall that the surface area of this landlocked water basin has decreased noticeably, and its level is falling quickly. If we do not save the graying Aral, in the near future we may find a scorching salt marsh in its place. The storms will carry the salty dust to irrigated land, changing the climate of the surrounding territory.

All of this has raised the issue of diverting part of the flow of the Ob' and Yenisey to the south. What seemed to be in the realm of science fiction not that long ago is now clearly worded in decisions of the 25th CPSU Congress: "Conduct scientific research and initiate, on its basis, the planning of the diversion of part of the flow of northern and Siberian rivers to Central Asia and Kazakhstan...."

More than 120 scientific collectives and planning organizations are working on this task. An integrated research program is being carried out with the purpose of thoroughly evaluating the diverse climatic, ecological, and economic factors. And although the end of this work is still far away, the initial findings allow us to envision the complete picture of the grandiose project. Let us try to mentally travel a few five-year plans ahead, almost to the beginning of the third millenium.

Having spent tens of billions of rubles, and having surmounted numerous technical difficulties, the Soviet people have laid a canal from Siberia to Central Asia--the largest hydraulic engineering structure on the planet. A journey along it would not be a short one. The total length of the main channel is almost 2,300 kilometers, making it the country's tenth-longest river.

It begins at the town of Belogor'ye on the Ob'. Below Tobol'sk, where the Vagay meets the Irtysh, the main channel begins. It drains through the Irtysh-Tobol'sk floodplain, with its capacity not inferior to that of the Volga in its central reaches. The mass of ultimately pure Siberian water crosses into the valley of the Ubagan River, to the Turgayskoye depression on the watershed between the Irtysh and the Syrdar'ya. Contrary to the laws of gravity, the upward current of the manmade river is assisted by highly powerful pumping stations--four stages at hydraulic engineering facilities along the Lower Irtysh, and four along the canal itself. They raise the water 100 meters, transferring it across the plateau of the Turgayskoye watershed.

The builders of the pumping stations relied on the experience of the developers of the Karshinskaya Steppe, who raised the Amudar'ya's water more than 130 meters at the beginning of the distant 1970's. Here as well, on the great Siberia-Central Asia canal, powerful pumps produced by the Ural Heavy Machine Building Plant imeni Ordzhonikidze are operating faultlessly.

Having surmounted the plateau, the wide canal then extends along the right slope of the Turgay River, coming to rest in the Tengizskoye Reservoir. This is one of the country's largest manmade water basins. It has room for up to 14 cubic kilometers of water, and it keeps the powerful current rushing southward uniform. From here on, it is navigable for the rest of the route; it turns southeast, in the vicinity of the village of Dzhusaly, it crosses the Syrdar'ya channel, and it once again proceeds southward to the Amudar'ya. The Siberian waters meet the waters of the self-willed "Jayhun" at the foothills of the southern slopes of the Sultanuizdag range in Kara-Kalpakiya.

But the canal is not just simply navigable. Large river steamships and barges travel along it. And there is plenty of clearance beneath the keel. The channel is 12 meters deep and 120-170 meters wide, even after the release of 25 cubic kilometers of water following completion of construction of the first generation.

The channel of the main canal is virtually the trunk of a huge tree. Its branches are represented by huge canals that carry water to vast regions of new irrigated land. These canals extend eastward to the Severo-Kazakhstanskaya, Turgayskaya, and Kyzyl-Ordinskaya oblasts, and westward to Kurganskaya, Chelyabinskaya, Orenburgskaya, and Kustanayskaya oblasts. Tens of millions of hectares of arid land have been irrigated. The existence of agriculture in this area is guaranteed. New towns and cities are springing up one after the other on the developed land. Viewing the inhabited banks and the broad surface of the flowing water, one recalls Engels' apt words with new meaning: "Man influences nature in response, changing it and creating new conditions for his existence.... The land surface, the climate, vegetation, and animal world, and even the people themselves have changed beyond recognition, and all of this has been due to human activity...."

Having made our way to the end of the main canal, we traveled almost 2,300 kilometers, but we have not yet finished our journey. Transferring to a small steamship, we sail on, along a canal connecting the main channel to the Tuyamuyunskoye Reservoir. This reservoir was instrumental in transferring Siberian water to the masses of old irrigated land in the productive Khivinskiy Oasis.

This is not a hare-brained scheme. It is a journey into the future, one that has its beginning in today. Its outline takes form in the endless pages of planning documents and countless economic computations that have passed out of the womb of electronic computers.

The scope of the research and planning efforts is the product of not only the scope of construction. The planned canal between the Ob' and the Sea of Aral is the greatest effort to alter natural conditions on earth. This is why so much careful topographical, hydrometric, geological, economic, and ecological research is being conducted. The task is to do no harm to the natural conditions and the climate, and to heed the laws of nature. Friedrich Engels himself cautioned that

"freedom lies not in an imaginary independence from the laws of nature, but in recognition of these laws and the knowledge, based on this recognition, of the possibility for intentionally causing the laws of nature to operate in behalf of particular goals...."

Scientific data accumulated by scientists permit us to conclude that the unfavorable consequences of implementing the grandiose project would be neglible. After all, only a small proportion of the flow of the great Siberian river will be diverted. But scientists are continuing to study the possible influence of this project upon the natural complex of West Siberia, upon the behavior of ice in the Gulf of Ob', and so on. They are searching for specific routes for the main and branch channels, ones which would do the least harm to the basins of the Siberian rivers. We recall Marx saying that "...culture--if it is allowed to develop spontaneously, and if it is not consciously guided--leaves nothing but a wasteland behind it...."

Basically, unfavorable conditions may reveal themselves at the sites of reservoirs. We must consider the flooding of agricultural land in such areas, and the reservoir design would be such that the least amount of fertile land would be submerged. Natural processes that may occur at river mouths are being studied over and over again. Because of reduced flow, salty sea water may penetrate more deeply into the delta, and river water may carry less heat in. Nor can we discount the change that would occur in the level of the water table. Too much water incompetently used in the southern regions may promote salinization of the soil. Clarifying these problems has become the task of scores of scientific collectives.

Considering the scale of construction, the planners are trying to think out all of the aspects of the technical and economic grounds of the project. Take transportation as an example. In the 12 years of the canal's construction, about 180 million tons of construction cargo and equipment will have to be conveyed. The forms and composition of transportation will be the most diverse, and it will have to operate over the tremendous territory through which construction will extend, territory varying in the degree of its development. More than 70 percent of the cargo will be handled by a motor highway along the canal route.

Yu. Lavrov, the main transportation specialist of the USSR Ministry of Land Reclamation and Water Resources' "Soyuzgidrovodkhoz", reported in one of his newspaper statements that the total length of just the rail approaches to railside bases and into the regions of construction is 240 kilometers.

The most sensible traffic scheme for the zone of canal construction has been adopted and recommended for further study.

All structures have been divided into two groups in terms of their purpose and composition. The first contains structures supporting the shipment of cargo and passengers. It includes rail and motor roads, airfields, and helicopter landing pads.

The second group consists of structures supporting restoration of transportation links that will be cut by the canal. They include rail bridges and ferry crossings over the canal for existing roads, underwater oil pipeline crossings, and so on.

The size and cost of construction of bridges and underwater oil pipeline crossings has been determined depending on the breadth and depth of the canals.

The canal will provide a great deal of high-quality water to both industry and agriculture. But scientists warn that the demand for water will grow. Territorial redistribution and dilution of contaminated water cannot fully solve the problem alone. We need an integrated approach to water consumption.

We will need to treat all industrial, municipal, and domestic wastes more carefully, and convert industry to closed production cycles . This will also predetermine the scale of further changes in ecology and the natural environment, and in the bio-medical conditions of man's life and labor.

A thrifty attitude toward water is closely associated with the general problems of sensible water use. It will be at least a decade before the abundant Siberian waters will reach us. And during this time we will have to make even fuller use of the existing reserves, which are not large. The volume of water flow in Central Asia and Kazakhstan is now 130 cubic kilometers, while in low-water years it is 95, and there is no small number of such years.

This means that we need to sensibly consume and strictly account for irrigation water--a real treasure and the foundation of our harvest. Without waiting for Siberian water, we could find millions of cubic meters more through sensible use of the existing discharge. Incidentally, we know that excessive irrigation not only means unjustified water consumption but also lower yields. Water produces a maximum benefit only when irrigation is practiced in correspondence with the needs of plants.

The following figures attest to the results of careless use of water. A number of oblasts consume 1,200 cubic meters of water per hectare in opposition to the established norm of 1,000 cubic meters. On the scale of the republic as a whole, such overconsumption in just one instance of irrigation would be equivalent to 340 million cubic meters, while the waste resulting from three instances of irrigation would be about a billion cubic meters, or all of the contents of Kattakurganskoye Reservoir.

The fabulous plans for transforming the land are being implemented through the will of the party and the labor of the people. As we solve the problems of interregional redistribution of water resources, grandiose in their intent and scope, a thrifty attitude toward these water resources is acquiring special significance.

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SCIENTIFIC AND TECHNICAL ANALYSES

UDC 911.2:482.215(-925.11+-925.2)

BALANCING WATER FLOW BETWEEN THE TWO RIVER SYSTEMS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOGRAFICHESKAYA in Russian No 2, Mar-Apr 79 pp 46-52

[Excerpts from article by G. P. Medvedeva: "A Study of the Synchronism and Asynchronism of the Flow of Western Siberian and Central Asian Rivers"]

[Excerpts] Because of asynchronism of the Western Siberian and Central Asian river flows, which causes variation in the amount of water available for withdrawal from the first region and consumption in the second, the author concludes that long-term regulation of the amount of diverted water would be advisable.

It is common knowledge that Central Asia suffers from a lack of water. This limits further development of the irrigated farming which is especially effective here due to the great heat resources. The optimal coordination of heat and water resources is necessary for the development of highly productive farming. Such coordination can be achieved in Central Asia by diverting a portion of the Western Siberian river flow to the area and utilizing local water resources with maximum efficiency.

Central Asia is unique among the regions of the Soviet Union, since such subtropical crops as cotton may be grown there. However, irrigated farming is faced with paucity of water which worsens every year. Supplying this region with water from the northern rivers will make possible greater correlation of heat and water here and open up broad opportunities for the intensive development of irrigated farming in Central Asia.

Among the many problems associated with diverting the flow, the study of synchronism and asynchronism of Western Siberian and Central Asian river flows is both interesting and necessary. Such research will make it possible to evaluate the possible consequences of diverting part of the flow of the rivers of Western Siberia to Central Asia when the water content of the rivers of these two regions is dissimilar.

The optimum condition for diversion of the flow would be the presence of asynchronism of fluctuation in the regions under comparison. When there is high water in the north and low water in the south, surplus water from Western Siberian rivers may be diverted without damage to this territory. On the other hand, low water

in Western Siberia and high water in Central Asia would require more intense utilization of local water resources, especially of that portion which was stored in reservoirs during high water periods.

Synchronous fluctuations of the river flows of the two regions would also present the opportunity for developing long-term forecasting of flow fluctuation and regulation of water delivery from north to south.

Thus, analysis of yearly flow variations of the Western Siberian and Central Asian rivers over a period of 60 years showed that favorable conditions for diverting the flow do not always occur. In all probability, conditions for diverting the flow could be made more favorable if, during high water years, water reserves were created on Western Siberia's rivers, so that water could be delivered southward to the rivers of southern regions during low water years. At the same time, water storage should be implemented in Central Asia itself during high water years.

As is known, conditions for constructing major reservoirs are extremely unfavorable in the territory of the Western Siberian lowlands. But it would probably be possible to set up a system of reservoirs upstream on the Ob', the release of which could compensate for the flow withdrawn from the Irtysh and Ob' and diverted to the south, which is especially important in low water years. As far as regulation of the Central Asian river flow is concerned, M. I. L'vovich (1977) indicates that it would be more expediently done in the mountains where a system of reservoirs could be constructed for long-term regulation.

Thus, in future conditions, the fluctuations of the river flows in the two regions under examination will gradually lose their natural characteristics, but according to a measurement of the increase of the weight of the regulated process, the synchronism or asynchronism of river flow fluctuation will have less importance.

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8945
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CONTRIBUTIONS OF CENTRAL ASIAN INSTITUTE TO RIVER DIVERSION WORK DISCUSSED

Moscow GIDROTEKHNIKA I MELIORATSIYA in Russian No 11, Nov 79 pp 42-45

[Article by Vadim Igorevich Antonov, director of Sredazgiprovodkhopka "The Contribution of the Central Asian State Planning-Surveying and Scientific-Research Institute for Irrigation and Land-Reclamation Construction imeni A. A. Sarkosov to the Development of Irrigation in Central Asia"]

[Excerpts] The Central Asian State Planning-Surveying and Scientific-Research Institute for Irrigation and Land Reclamation Construction imeni A. A. Sarkisov celebrated the 50th anniversary of its formation.

The institute is the oldest organization in the country which works out plans for big hydraulic works, integrated plans for the irrigation and development of virgin tracts in the republics of Central Asia, Southern Kazakhstan, and abroad, and long-range plans for the development of irrigated agriculture and the use and protection of land and water resources in the basin of the Aral Sea. The institute was created on the base of the State Central Asian Irrigation Planning-Survey Trust of Sredazvodproiz [expansion unknown] which was subordinate to the Main Administration for Water Resources of Central Asia. The trust combined in one institution all surveying and planning work for the needs of land reclamation construction on the territory of the young Central Asian republics. Its creation marked the beginning of the profound study and development of the land and water resources of this region for the needs of agriculture.

As is known, all planning of irrigation development in Central Asia and Southern Kazakhstan is now conducted on the basis of the materials and recommendations of the schemes which have been mentioned. On the basis of all accumulated experience and long-range studies, in 1973 the institute drew up a scheme for the integrated use of the water resources of the Aral Sea. In it, the necessity and expediency of diverting part of the flow of the Siberian rivers into the Aral Sea basin were substantiated for the first time and a basic technical scheme for the rational use of Siberian water was proposed while the volumes and times for the diversion were determined.

Now, in the overall program of work for the diversion of Siberian stream-flow the institute is accomplishing important studies on the rational distribution of this stream-flow in the Central Asian region and is also working out measures for the development of water resources, the rebuilding of old irrigation systems, reduction of mineralization of river and return water, reregulation of the flow of

local rivers, and so forth. Long-range studies are being conducted on the development of the irrigation of new virgin tracts in the Karshinskaya and Farishskaya steppes and others. The volume of long-range studies will be increased significantly at the institute in the next few years.

The institute is facing important and difficult tasks in the further development of irrigation agriculture in Uzbekistan and other Central Asian republics, the technical improvement of irrigation systems on the basis of scientific and technical progress, the most effective use of the tremendous potential possibilities of the region, and on studying the biggest water management problem of modern times which was outlined by the 25th CPSU Congress--the diversion of a portion of the flow of Siberian Rivers to Central Asia.

6367
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PROBLEMS CAUSED BY INCREASED GROUND WATER FLOW

Alma-ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 11, Nov 79 pp 7-12

[Excerpts from article by U. M. Akhmedsafin, Sh. M. Aytaliyev, M. A. Vinitskaya, M. Kh. Dzhabasov and R. M. Kurmangaliyev: "Prediction of the Ground Water Flow in the Zone of Influence of the Canal Diverting a Portion of the Siberian River Flow to Kazakhstan (in the Aral Sea area of the Kara'Kum)"]

[Excerpts] The current level of scientific-technical progress is making it possible to develop and implement an immense construction program of extensive hydraulic engineering and irrigation systems. Among the many similar programs a prominent place is occupied by the one to construct a canal to divert part of the Siberian river flow to Kazakhstan and Central Asia. This canal, in its parameters, is a unique hydraulic engineering structure whose main section (1,500 km) passes through northern, central and southern Kazakhstan. Introducing the large water artery (with a flow rate of 60 km^3/year) in the republic's territory through the Turgayskaya depression will substantially alter the hydrogeological conditions in the Turgayskaya plain, and the areas of the Kara-Kum Desert near the Aral Sea, and the western Kyzyl-Kum Desert, which in turn will impact on a number of other elements of the ecological system.[1]

It is important to study and to calculate in advance the seepage of water from the canal and its interaction with the ground water. As observations of the impact zone of the Kara-Kum Canal have shown, such water seepage has caused the formation of seepage lakes and swamps, waterlogging of the soil and intensive growth of vegetation (hydrophytes, hygrophytes and phreatophytes) leading to the formation of new ecosystems.[2] The Kara-Kum Canal may also serve as a "natural" model for tracing the basic laws of effect of a large hydraulic engineering structure on the environment. However, regardless of some similarities of hydrogeological characteristics of the planned canal route with the Kara-Kum Canal route, special studies will have to be made to obtain reliable predictions. A completely valid predictive evaluation of the canal's effect on the natural environment can only be produced by detailed, quantitative analysis of water seepage from the hydraulic engineering structure and its interaction with the ground water based on precise methods using effective technical means along with qualitative methods. The final elements method (MKE),[3] which began to be used for solving seepage problems comparatively recently, has a great potential in this aspect.

When the direct, steady-state problem was solved it was found that the maximum rise of water tables at points nearest the canal affected by a head amounted to 1.5-2 meters, while the performance of the canal on both sides was affected by it for a distance of 8-10 km, and covering, in general, a zone 16-20 km wide.

The time problem was worked out using 5-year intervals. In all three profiles, it was noted that the water table rose considerably during the first 10 years, essentially reaching its maximum during this period and subsequently it will be insignificant. A steady-state condition is only reached after 20 years.

The raised water table resulting from the development of a head will cause a change in the natural hydrogeological conditions in the canal's zone of influence, which will appear in the following:

1. In areas where there is dispersion of windborne sands to a depth of 15-20 meters, flooding of inter-hill and inter-ridge depressions is possible, with the formation of seepage ponds and swampy areas, which in conditions of high evaporation leads to salinization of the area;

2. A change in mineralization and the chemical composition of the water table may occur in areas subject to their fluctuation, which results in the processes of flushing salt out of the rocks of the aeration zone and evaporation from the water table as a result of the increase in the water levels.

Thus, the method we have reviewed will permit long-term predictions to be made about the development of varying ground water conditions due to the effects of large hydraulic engineering structures. It is extremely efficient and could have widespread practical application, particularly for estimating seepage loss along the length of the canal which would divert part of the Siberian river flow to Kazakhstan and Central Asia.

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EXCERPTS FROM TWO-PART ARTICLE DEALING WITH CASPIAN SEA PROBLEMS AND RIVER DIVERSION

Moscow GIDROTECKHNIKA I MELIORATSIYA in Russian No 11, Nov 79 and No 1, Jan 80

[Article by Ye. Tret'yakov]

[No 11, Nov 79 pp 72-74]

[Excerpts] In our time, the colossal water resources of the Volga have been placed at the service of the national economy. A cascade of giant hydraulic power systems with large-capacity reservoirs which were constructed in the 1950's and 1960's provided the industrial enterprises of Moscow and the cities of the Volga region with electric power and improved navigation conditions on the Volga which now connects the capital with five seas. After the Saratov Canal and a number of other systems were put into operation, Volga waters are irrigating many thousands of hectares of land which formerly suffered from drought.

However, in recent years the Volga has begun to need protection. Swiftly growing industrial production is causing the contamination of the river with waste water. The decrease in agricultural run-off is increasing with the development of irrigated farming. The intensifying diversion of water to satisfy the urgent needs of the national economy requires the replenishment of water resources of the Volga and the Caspian.

These problems, which are important for the entire Volga basin, are added up and aggravated toward the mouth of the river. The flow of the Volga is being reduced gradually, which may lead to undesirable consequences. The Caspian, which experiences century-old fluctuations in level, is receding from the shores, growing shallow, and becoming salinized. The journal's correspondent talked about these problems with associates of Astrakhan organizations which are conducting important work on protecting the Volga and the Caspian.

Last year, the great water content of the Volga also had an influence on the improvement in the quality of surface water: as a result of abundant precipitation its flow was 50 cubic kilometers greater than usual (245 cubic kilometers instead of 195 cubic kilometers the preceding year). This year also proved to be favorable as regards water content. On the whole, the waters of the Volga are becoming much cleaner.

[No 1, Jan 80 pp 72-74]

Meanwhile, a difficult hydroeconomic situation has now arisen in the Volga basin. A most acute water shortage--for irrigation and drinking--is being experienced in many regions. In the low-water period, some of the rayons of Astrakhan oblast are being left virtually without fresh water since the sources of water supply are growing shallow, are being diverted from the Volga, and losing flowage; the water in them is stagnating, acquiring a peculiar odor and color, and becoming unsuitable for drinking.

The problem of the dependable water supply of the Akhtuba River and its branches is especially acute. In the summer, the Akhtuba dries up in several places, closed water lenses are formed and, you see, 120,000 hectares of irrigated lands are suspended here. Now Soyuzvodproyekt [All-Union Association for Water Management Planning] and Astrakhangiprovodkhoz [Astrakhan State Planning, Surveying, and Scientific Research Institute of Water Management Construction] have worked out a long-range plan for increasing the dependable water supply of the Akhtuba. The plan envisions the construction of 3 delivery pumping stations and 63 structures on the right-bank shallow channels, and the deepening and straightening of the river's channel. In several years, 285 cubic meters per second will be fed to the Akhtuba in the low-water period, and subsequently--380 cubic meters of water.

Kaspvodnadzor [expansion unknown] has conducted important work in preparing plans for water consumption on the Akhtuba and for regulating the establishment of cut-off levees which are erected here in the low-water period to create reserves of water for the growing season. The new irrigation systems will not be tied to the Akhtuba prior to 1985.

The volume of spring high water has been reduced especially sharply during the last 7 years (1971-1977)--on an average down to 93.7 cubic kilometers. The volume of flow during high water in relation to the annual, which comprised 61.4 percent in 1930-1940, was reduced to 41.1 percent. The date for the ending of high water shifted from 14 July to 17 June, and its mean duration decreased from 73 to 43 days.

Transfer of the Northern Rivers

However, a radical solution of the Caspian problem will be the transfer of a portion of the flow of the northern rivers to the Volga basin. Nine reservoirs are being planned, the construction of which it is intended to accomplish in three stages: in an eastern direction during 16 years (stage one in 9 years) and in a western direction--in 15 years (stage one in 6 years).

The Bureau of the NTS [scientific and technical council] of the Ministry of Land Reclamation and Water Resources of the USSR approved a complex of hydraulic works for the first diversion phase for a volume of 37.4 cubic kilometers per year to include 7.1 cubic kilometers from Lake Onega, 6.6 cubic kilometers from Lakes Lacha, Vozhe, and Kubenskoye and the headwaters of the Sukhona River, 10.2 cubic kilometers from the Sukhona and the headwaters of the Severnaya Dvina, and 13.5 cubic kilometers from the Pechora River with total capital investments of 2.3 billion rubles.

Construction conditions and the volume of capital investments permit constructing the diversion systems which are part of the first stage from Lakes Onega, Lacha, Vozhe, Kubenskoye and the headwaters of the Sukhona for a volume of 10.1 cubic kilometers in 5 years. The partial diversion of a portion of the flow of Lakes Onega, Lacha, Vozhe, Kubenskoye, and the headwaters of the Sukhona River in a volume of 10 cubic kilometers through the Rybinskoye reservoir is proposed on the first stage. The diversion of a portion of the flow of the Onega, Severnaya Dvina, and Pechora Rivers to the Volga is proposed in the second stage.

Soyuzgiprovodkhoz [All-Union State Planning, Surveying, and Scientific Research Institute of Water Management Construction] has also worked out a theme for diverting part of the Volga flow to the Don. Various versions for diverting Volga water to the Don with a water intake from the mouth of the Volga to Saratovskaya oblast were examined. It was learned that with the intake of water from the Volgograd reservoir damage is inflicted only on small fish while with the water intake from the Lower Volga main damage is inflicted on the natural reproduction of the sturgeon, which is impermissible. Adjudged most expedient on the first stage (volume of diversion 6 cubic kilometers per year) was the version with water intake from the head race of the Volga GES at the village of Yerzovka with an estimated cost of the work of the first phase of 244 million rubles.

The doubtlessness and necessity for diverting a portion of the flow of the northern rivers causes no doubts. Such a diversion will prevent a further drop in the level of the Caspian Sea, will preserve 23,000-25,000 square meters of area of its northern part and 100-120 cubic kilometers of volume of its water mass, will improve the salt conditions of the Northern Caspian and Azov Seas, and will permit preserving the unique fish reserves of these seas; it will also permit raising the generation of electric power at the Volga and Kama GES's, increasing the carrying capacity of the Volga and Kama and, accordingly, of the single deep-water system of the European portion of the USSR, and will create a tie with the rich natural resources of the Komi ASSR. The diversion will permit reviewing the operating regime of the Volga-Kama cascade of the GES and the release of water from the reservoirs to the Volga delta, working out the optimum version for the use of water resources for the needs of the various branches of the national economy, and bringing the hydrograph of the high waters in the Volga delta closer to the natural.

The land reclamation workers, the personnel of the fishing industry, workers of the fields, and residents of the cities are awaiting the diversion of a portion of the northern rivers' flow with impatience. Further development of power engineering, industry, fishing, and transportation is impossible without it. In short, the entire national economy of the Lower Volga is extremely interested in the diversion of the northern rivers.

6367
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RIVER DIVERSION NECESSARY TO PROGRESS OF IRRIGATION-RECLAMATION PROGRAM IN CENTRAL ASIA

Ashkhebad PROBLEMY OSVOYENIYA PUSTYN' in Russian No 1, 1980 pp 21-28

[Article by O. K. Kamilov: "On Principles of Reclamation of Saline Soils in Semi-desert and Desert Zones"]

[Excerpts] About half the irrigated lands in Central Asia are to one degree or another saline soils. In truth, during the last 15 to 20 years these areas have been significantly curtailed by reclamation work, and there are more than 27.5 million hectares of soil suitable for irrigation. They lie primarily in the desert zone, in the territory of Uzbekistan and Turkmenistan.

In Turkmenistan there are about 12 million hectares where irrigation is feasible. Of this about 6 million hectares are in southern Turkmenistan (in the Kara-Kum Canal Zone) and more than 6 million hectares in the northern part.

In the desert zone most of the lands are takyric (takyr-like and takyrs), gray-brown and desert sandy soils and to a lesser degree--meadow and other hydromorphic soils. More than 80 percent of these soils are saline to begin with or inclined to secondary salinization upon irrigation.

With its abundance of land resources, Central Asia, as is well known, is characterized by extremely limited water resources. According to data of water management calculations, with the most economic utilization of internal water resources the area of irrigated lands in all of Central Asia (including southern Kazakhstan) can be expanded by another 2.5 million to 3 million hectares and when added to the presently irrigated land, the total would amount to 7.5 million to 8 million hectares. The need for the planned diversion of part of the flow of the Siberian rivers into Central Asia is defined by these circumstances.

The irrigation water deficit is growing ever greater. In connection with this, every kind of economy and rational utilization becomes a vital necessity. Therefore, when lands are undergoing irrigation development and desalinization we must strive to bring water losses to a minimum and to achieve the greatest desalinization of the soils with the least expenditure of irrigation water. For this it is necessary to apply the optimum reclamation system for soils in each object of development in accordance with its natural properties.

The optimum reclamation system for saline soils is a favorable combination of elements of natural conditions, in which the best water-salt regime for the soils is established, guaranteeing the maximum desalinization of the ground and ground water, and the best conditions are established for a steady increase in biogenic activity and productivity of irrigated soils.

The Institute of Soil Science
and Agrochemistry of the Academy
of Sciences of the Uzbek SSR

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15 May 1979

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INFLUENCE OF RIVER DIVERSION CHANNELS ON THE DESERT MICROCLIMATE CONSIDERED

Ashkhabad PROBLEMY OSVOYENIYA PUSTYN' in Russian No 1, 1980 pp 9-15

[Article by B. G. Bager, N. S. Orlovsky and Z. M. Utina: "Influence of the Canal on the Desert Microclimate"]

[Excerpts] An important task, the solution of which is necessary for predicting the consequences of diversion of part of the flow of the Siberian Rivers into the southern regions of the country, is the appraisal of the change in the meteorological regime in the zone through which the diverted streamflow will pass. Evaporation from the canal and the lowered temperature and increased humidity connected therewith may turn out to be significant in the area along the bank, and this situation needs to be considered in working out a diversion plan.

A feature of the process of transformation of properties of air over the canal is that the dry, superheated air arriving at the canal is cooled in the lower layer due to evaporation, and then again moves onto the dry, superheated underlying surface. A process of secondary transformation begins. As a result the air mass over a certain point situated at some distance from the leeward bank of the canal turns out to be vertically nonhomogeneous. The lowest layer of air adjoining the underlying surface is under its direct influence and, consequently, has rather high temperature and low humidity. Over it is situated a second layer, the temperature and humidity of which are transformed under the influence of the canal. Still higher is a third layer, where changes connected with the canal are totally absent.

We may use data on the influence of the Kara-Kum Canal imeni V. I. Lenin on the meteorological regime on the surrounding territory as a characteristic example of the interaction of the canal with the environment. Such data were gathered on a joint expedition of the Main Geophysical Observatory imeni A. I. Voyeykov and the Institute of Deserts of the Academy of Sciences of the Turkmen SSR in August of 1974. During the expedition a complex of observations of the meteorological characteristics of the surface layer of the atmosphere at the water's edge and at 30 and 300 meters from the bank of the canal were carried out on the bank of the canal at a width of 100 meters and 30 kilometers from the Zakhmet railroad station.

The course of the main canal in realizing the plan for diversion of the flow of the northern rivers into Central Asia will pass through various physico-geographic zones, and its effect on the climate in these regions will be manifested differently.

Appraisal of its effect in all seasons and along the entire course on the basis of analysis of empirical data is impossible. The method of physico-mathematical modeling of processes of heat and moisture transfer in the atmosphere may be utilized to solve this problem.

All these particulars of air transformation under the influence of a change in properties in the underlying surface are calculated according to a theoretical model and correlate well with the theoretical data. This agreement makes it possible to recommend a theoretical plan for calculating characteristics which have great practical significance, but which are subject to experimental determination only with difficulty.

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The Order of Labor of the Red Banner Main Geophysical
Observatory.

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ENGINEERING AND ECOLOGICAL PROBLEMS IN WATER MANAGEMENT

Moscow VODNYYE RESURSY in Russian No 1, 1980 pp 14-29

[Excerpts from article by A. M. Chernyayev: "Engineering and Ecological Problems in Water Supply Development"]

[Excerpts] With all the variety of approaches used in solving the problem of water supply for the population and for the national economy, and in spite of the successes achieved in the construction of facilities for collecting, transporting, and purifying water, and so on, water management in the region is still basically dependent on extensive use of the natural water resources, although it must be acknowledged that with the aid of engineering methods and techniques very effective means have already been developed for intensified utilization of the natural waters (for example; temporary, territorial, and spatial regulation and redistribution of streamflow, use of the river systems to transport industrial and domestic wastes with regulation of river water quality by treating the effluent and diluting with fresh water). All this has led to the formation of complex water supply systems, transformation of some rivers into elements of large water management systems with practically complete utilization of their water resources in the economic cycle (in the Urals this applies to the Tura, Tagil, Iset', Miass, and other rivers), creation of inter-basin water management systems (Sverdlovsk and Nizhniy Tagil VKhS [water management systems]), and so on. A considerable volume of fresh water is used in waste water dilution, but the water protection effect achieved is negligible. In essence, the fresh water is expended unproductively.

At the present time the engineering-ecological approach to water management activity is being introduced everywhere; the objective of this approach is the simultaneous solution of two problems--the water supply and the protection of the natural waters of the rivers and lakes. A very simple example of the engineering-ecological principle in industrial water supply organization is the creation of water cycling systems and systems for purified waste water reuse.

The primary drawback of recycling water supply systems is the necessity for systematic replenishment of the systems with fresh water, not only to replace the irreversible losses but also to replace the so called "flushing" discharge, which is used to prevent salinization of the recycled water. As a rule the saline "flushing" waters are discharged into rivers or urban sewer systems and thereby cause considerable degradation of the quality of the natural water.

From this viewpoint the "no-waste" water supply systems, in which the recycled water not only has the impurities removed but is also desalted, are more advanced and are used in a number of enterprises. The only "wastes" are the solid wastes remaining after purification and desalinization. Such systems are being designed, for example, for the Magnitogorsk Metallurgical Combine and for the Pervoural'sk Pipe Manufacturing Plant.

The measures examined above are in competition with some variants of proposals for additional water supply to the Ural region from a primary canal with redistribution of part of the flow of the Siberian rivers to Central Asia and Kazakhstan. In any case, when the final decision on distribution of Siberian water is made the alternative variant of water recycling on the basis of intensive utilization of the local natural water resources must be considered.

At the present time the most urgent problem is that of water supply for the national economy of the oblasts of the eastern slope of the Urals (the Sverdlovskaya, Chelyabinskaya, Kurganskaya and Orenburgskaya oblasts). In the northern part of Sverdlovskaya Oblast flow the Tura and Tavda Rivers, which are part of the Tobol-Irtysh-Ob' Basin. About 42 percent of all the natural water resources of the territory of the four oblasts named above is formed in the Tura and Tavda basins.

The Soyuzgiprovodkhoz [All-Union State Planning, Surveying, and Scientific Research Institute of Water Management Construction] and Yuzhuralgiprovodkhoz [Southern Ural State Planning, Surveying and Scientific Research Institute of Water Management Construction] are studying the advisability of diverting part of the flow of these rivers along the eastern slope of the Urals right up to the sources of the Ural River, with the objective of eliminating the water shortage for the next 20-25 years.

Concerning the proposals on taking part of the flow from the Tavda River there are several contradictory viewpoints. Some specialists consider that it will be easier to supply the Ural with water from the primary canal for diverting water from the Ob'. (See above.)

In connection with this, in the opinion of this author, one very important circumstance should be noted. Territorial redistribution of the Tavda water can very well serve as the basis for the creation of an integrated water management system (OVKhS) for the eastern slope of the Urals, which in the future, on the basis of ASU [automated control] of this system together with intensive use of the local resources and expanded recycling of industrial water will make it possible to entirely avoid use of the Ob' River water.

The first phase of the development of this system can be limited to the Tobol basin, without diverting water into the Ural River. In this case, locating the upstream water collecting structures on the Tobol River (below the confluence of the Tavda River) and redistributing the water to supply the industrial and agricultural regions of the eastern slope of the Urals, we can create the large Tobol basin water management system.

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CANAL CONSTRUCTION FOR DIVERTING WATER OF SIBERIAN RIVERS DESCRIBED

Moscow GIDROTEKHNICHESKOYE STROITEL'STVO in Russian No 1, Jan 80 pp 5-8

[Article by A.Ye. Azarkovich, candidate of technical sciences and P.P. Chatalbashev, engineer: "Conditions of Use and Planning Indicators for Blasting Method of Construction for the Deep Sectors of a Canal for Diverting a Portion of the Flow of Siberian Rivers"]

[Text] In the principal conditions of the TEO [technical and economic substantiation] for diverting a portion of the flow from Siberian rivers into Central Asia and Kazakhstan, the plans call for the so-called eastern direction of this diversion to pass through the Turgay Depression to the watershed divide between the basins of the Irtysh and Syrdar'ya Rivers [1].

The water intake will be carried out from the Ob' River in the region where the Irtysh River joins it, through the installation of a system of hydraulic engineering complexes and navigable locks, which will ensure the transformation of the Irtysh River, in the sector between the cities of Tobol'sk and Khantymansiysk, into an "anti-river." Some parameters for the canal and the 1st phase of the diversion are herewith furnished:

Length, kilometers	2273
Width along bottom, meters	20; 40; 8
Width at top, meters	200-300
Length of sectors with deep excavation	
Up to 12 meters	22% of overall length
12-24 meters	68%
24-34 meters	10%
Inclination of slopes	1:3; 1:4; 1:6
Depth of water in canal, meters	13.4 - 15.5

The canal is marked out over soft soils (sandy loam, loam, clay), with the ground water occurring at various depths.

The tremendous volumes of excavation work, the differences in the planned dimensions of the canal and the diverse geological, topographical and other conditions along its route raised the need for examining various methods for carrying out the earth work, the principal ones of which are dry excavation, hydromechanized and blasting.

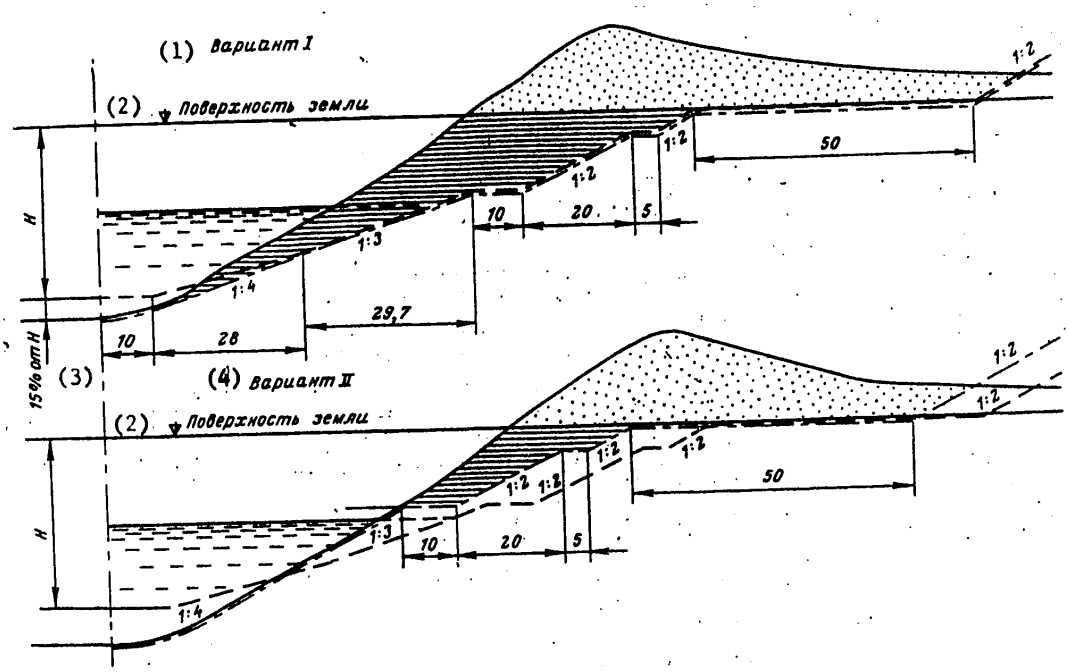

Figure 1. Variants of planned cross sections for canal with use being made of blasting method of construction

Key:

1. Variant I
2. Ground surface
3. 15% of H
4. Variant II

———— Contour of cleared out area and heap

- - - - - Planned contour when use is made of excavating equipment

-.-.-.-.- The same, with use being made of the blasting method of construction. The hatched-in areas represent the volumes of finishing work to be carried out following the blasts.

The dry excavation method is more highly developed, multi-purpose in nature and economical of use and under favorable conditions it is being employed more extensively in construction. The principal excavating machines include large self-propelled and towed scrapers and highly productive excavators. However, the required intensity in the excavation of soil in the deep sectors of the canal (more than 20 meters) can be achieved only through the use of a large quantity of such equipment.

The hydromechanical method for the construction of the 1st phase of the canal, owing to a number of factors, can have only limited use.

The blasting method -- using explosives for digging out areas -- can be a very promising trend, one which makes it possible to intensify the excavating of soil

and lower sharply the requirements for the powerful excavation equipment, which is in short supply. This applies first of all to the deep sectors of the canal.

The construction of the Palassovskiy, Amu-Bukharskiy, Severo-Tashkentskiy and Sary-Kurganskiy Canals, the Murgab Collector (3d Phase), the pioneer trench and 4th Phase of the Kara-Kum Canal, sectors of the Irtysh-Karaganda and Volga-Ural Canals and so forth, can be cited as examples of the effective use of the power of explosions. Planning studies and available experience reveal that when constructing canals in non-rocky soils, it is best to place the explosive charges in trenches. The use of trench charges makes it possible to mechanize all of the technological processes completely, to reduce labor expenditures and to concentrate the work in both space and time.

However, the scales of the trench charge explosions carried out were less than those required for the construction of a diversion canal. The following maximum values were achieved: depth of the charge trench 6.5 meters; linear mass of the charges 1.7 ton-meters; mass of the simultaneously exploding charge 1,750 tons; depth of the canal constructed 15 meters.

When examining the blasting method, it should be borne in mind that its use may be ineffective if certain of its characteristics are not taken into account. Experience has shown that in the construction of canals, when explosives are used in water saturated soils that have ground water deposits nearby and in soils having quick ground properties, the blast wave may bring about thixotropic changes in the soil with the excavation thus formed becoming filled with liquefied soil.

Adverse results from the use of massive explosions in water-saturated soils occurred during the construction of a collector-drainage network in the Golodnaya Steppe and the Kura-Araksinskiy Lowlands and drainage canals in Krasnodarskiy Kray [2].

Thus, when making plans for using the blasting method of canal construction, thorough engineering-geological and hydrogeological studies aimed at establishing the physical-mechanical properties of the soils are required.

When composing the TEO for the blasting method of constructing the sectors of the canal, two variants for the planned cross section of the canal were examined (see Figure 1):

...I The planned depth of the canal is accepted as being 15 percent greater than that obtained through the use of excavating equipment;

...II The planned area of the cross section of the excavation is ensured as being lower than the assigned water level mark.

These conditions ensure that the planned profile of the canal approximates the form of the cross section for an excavation caused by an explosion in clay soils. For both variants of the planned cross section of the canal, finishing work must be carried out by excavating equipment on the sides of the excavation caused by the explosion, in the first instance -- for the entire height of the side, and in the second -- higher than the water level in the canal.

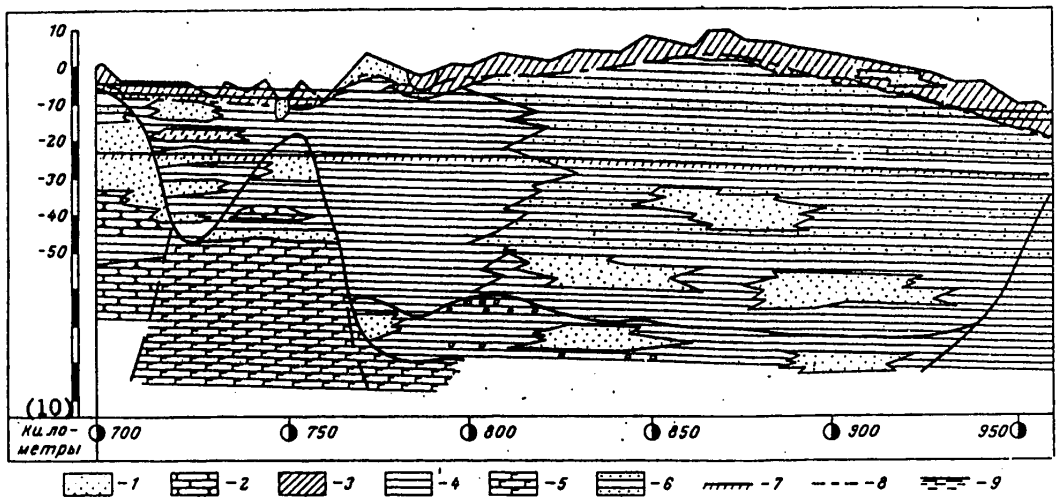

Figure 2. Longitudinal profile of middle sector of route of Tobol'sk-Amudar'ya Canal

Key:

1. Sand
2. Sandstone
3. Loam
4. Clay
5. Basalt
6. Interstratification of clay, sand, sandy loam and loam
7. Bottom of canal
8. Ground water level
9. Water level in canal
10. Kilometers

In order to employ the blasting method of construction, an examination was undertaken of sectors representing an overall length of 279 kilometers, in a region of deep excavations along 780-1,050 kilometers of route. The sectors were selected based upon the following requirements:

...a) the soil had to be clay deposits of average moisture content, thus making it possible to raise the stability of the sides of the charge trenches and the excavations and also to improve the technical-economic indicators for the blasting method;

...b) the planning requirements had to be achieved through the exploding of one trench charge;

...c) no populated points or important installations, either in operation or under construction, could be located close to the route.

The excavation volume for the selected sector of the route, which constitutes 12 percent of its overall length, equalled 800 million cubic meters (roughly 25 percent of the overall excavation volume for the route).

An engineering-geological survey revealed the following characteristics for this sector of the route (see Figure 2):

TABLE 1

Параметры и показатели (1)	(2) Вариант сечения канала I	II
ЛНС, м (3)	15,0—20,0 / 13,8—15,0	
(4) Показатель действия взрыва	2,6—3,8 / 2,6—5,5	3,1—4,0 / 3,1—5,7
(5) То же средневзвешенный	3,4 / 4,6	3,5 / 4,9
(6) Линейная масса заряда ВВ, т/м	2,55—12,2 / 2,55—17,0	3,8—13,6 / 3,8—18,0
(5) То же средневзвешенная	8,3 / 11,2	9,6 / 12,6
(7) Потребность в ВВ, млн. т	2,0/2,6	2,3/3,0
(8) Доработка сечения канала землеройным оборудованием, %	27—39	0—12
(9) То же средневзвешенное значение	32	8,3
(10) Удельный расход ВВ на 1 м³ выброса грунта, кг	2,9—3,7 / 2,3—5,2	3,2—3,7 / 3,2—5,0
(5) То же средневзвешенный	3,4 / 4,5	3,5 / 4,5
(11) Удельный расход ВВ на 1 м³ объемного канала, кг	1,8—2,7 / 1,8—3,8	2,9—3,3 / 3,2—4,4
(5) То же средневзвешенный	2,4 / 3,2	3,2 / 4,0

Key:
1. Parameters and indicators
2. Canal cross section variant
3. LNS [line of least resistance], in meters
4. Indicator of blast action
5. The same, weighted average
6. Linear mass of explosive charge, in ton-meters
7. Explosive requirement, millions of tons
8. Finishing off cross section of canal using excavation equipment, in %
9. The same, weighted average value
10. Specific expenditure of explosive per cubic meter of soil excavated, in kilograms
11. Specific expenditure of explosive per cubic meter of canal volume, in kilograms

...a) the ground water level occurs at a depth of from 2-3 to 5-7 meters from the earth's surface;

...b) the soils are represented by lake-alluvial quaternary deposits (clay soils with individual, local and shallow layers of sandy loam). Loam, sandy loam, sand and clay are encountered to a depth of 2-10 meters from the surface and lower -- clay with layers of sandy loam;

...c) individual layers of a soil thickness may contain water under local pressure, but the water flow is negligible owing to very low coefficients of filtration;

...d) the principal characteristics of clay soils: yield point 35-62 percent (average 45 percent); limit of flattening out 16-34 percent (average 20-25 percent);

plasticity number 19-28 percent (average 20-25 percent) and this makes it possible to classify clay as a poor soil.

The indicator for soil consistency is found mainly in the range 0-0.25 and thus it follows that they are of either hard or semi-hard condition.

Igdanite is used as the principal explosive in this construction work. It is prepared from components (95 percent ammonium nitrate and five percent diesel fuel) in the vicinity of the area in which the work is to be carried out. A large portion (75 percent) of the igdanite must be used in hermetically sealed polyethylene. In selecting the explosive material, consideration was given to the fact that the economic indicators for the blasting method of construction are substantially better when igdanite is employed than they are for other explosive materials.

The components for igdanite are not in short supply and the use of igdanite does not require a sharp increase in the production of explosive materials.

At the same time, the use of igdanite requires the creation of a complex of highly productive equipment for mixing the components of the explosive and for water-proofing and loading it. This complex must include railroad and truck tankers, saltpetre carriers, storage-hoppers for the saltpetre at sector storehouses, charge delivery motor vehicles for charging the dry trenches, mixing and batching-calibrating units at the sector storehouses, trucks and jib cranes for delivering and loading the water-proofed (polyethylene) igdanite and motor vehicles for delivering the diesel fuel.

The parameters for a blast are computed in two variants:

...1 According to minimal computed expenditures for the construction -- here the planned depth of the charge trenches must reach 21 meters.

...2 Upon the condition of a limitation on the maximum depth of the charge trenches on the order of 15-16 meters (angle of slope for sides of 60°).

For completing the charge trenches, the plans call for the use of ESh-15/90 walking excavators and for filling in the trenches following charging -- ESh-10/70A excavators jointly with 300 horsepower bulldozers. It is assumed that the selection of the proper slope angles will ensure a temporary stability for the sides of the charge trenches.

The method of the Gidrospetsproyekt Institute was employed for computing the parameters of the explosion [3].

The planning parameters and the indicators for the explosive work during construction of the canal are shown in Table 1 (in the numerator -- for a depth of the charge trenches up to 21 meters and in the denominator -- 15.5 meters).

The overall requirement for explosive material is 2.0-3.0 million tons (depending upon the variant) and thus for a computed duration of explosive work of 6 years, the annual requirement will range from 350,000 to 500,000 tons.

TABLE 2

Indicators	Blasting Method With Subsequent Finishing Off of Profile Using Excavation Equipment				Dry Excavation Method
	Canal Cross Section Variant				
	I		II		
	Depth of Charge Trench, meters				
	Up To 21	15.5	Up to 21	15.5	
Planned depth of canal, meters	19.5 - 38.5	19.5 - 38.5	-	-	From 20.2 to 32.2
Planned excavation volume, millions of m^3	850	850	760	760	830
Cross section area of canal, m^2	1400--4550	1400--4550	1200 - 4120	1200 - 4120	1410 - 4450
Cost of work, millions of rubles	569	598	520	545	458
Specific cost per m^3, rubles	0.67	0.71	0.69	0.72	0.55
Capital investments, millions of rubles	130	120	86	76	168
Corrected* expenditures, millions of rubles	864	894	762	776	976
The same, per m^3, rubles	1.02	1.05	1.00	1.02	1.28
Labor expenses, thousands of man-years	17.3	16.2	15.8	13.3	25.6
Duration of construction, years	8	8	8	8	10
Equipment requirements, units					
towed scrapers	63	63	82	82	70
self-propelled scrapers, 25 m^3 capacity	-	-	-	-	40
ESh-20/75B excavators	14	14	2	2	22
ESh-15/90A excavators	37	31	21	16	44
ESh-10/70A excavators	13	10	22	17	25
bulldozers for 300 horsepower tractors	71	59	63	50	101
complexes** for the transporting, storage and loading of the explosive	4	4	4	4	-

* The year of completion of construction, when use was made only of excavating equipment, that is, the 10th year since the beginning of construction, was used as the correction year.

** The complex includes facilities for storing the igdanite components, railroad tankers and saltpetre carriers (from 38 to 70 units), motor vehicle-saltpetre carriers having a carrying capacity of 25 tons (8-11 units), charge motor vehicles having a carrying capacity of 12 tons (2-4 units, trucks having a carrying capacity of 12 tons for transporting the explosive (4-8 units) and jib cranes for loading the explosive (2 units).

The finishing off of the profile of the canal following the explosion is carried out using walking excavators with buckets having a capacity of 10-20 m^3 and also powerful bulldozers.

A comparison of the blasting method against a construction technology employed on sectors of the canal in which use was made of excavating equipment -- walking excavators, large scrapers and bulldozers -- is furnished in Table 2.

In accordance with the work technology and the indicators obtained, it would appear that canal cross section variant II is the best one, with a charge depth in the trench of 15.5 meters. The indicators for this variant, expressed in percentages with regard to the corresponding indicators when use was made only of excavating equipment, are furnished below:

Cost of work (current expenditures)	123
Capital investments	45
Labor expenditures	56
Corrected monetary expenditures	83
Earnings	203

Thus the blasting method of construction can ensure:

...a reduction in corrected monetary expenditures of 17 percent (approximately 190 million rubles);

...roughly a twofold reduction in capital investments and labor expenditures;

...a reduction in the duration of construction of 2 years;

...a substantial reduction in the requirements for powerful excavators and large scrapers.

At the same time, the blasting method requires the use of special equipment -- complexes for preparing the explosive material and for transporting and loading it, with the scale of the explosive work to be carried out being unprecedented in international practice. A number of problems which determine the technological solutions for the more detailed stages of planning cannot be solved in the absence of experimental substantiation.

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PROBLEMS RELATED TO DECLINING LEVEL OF ARAL SEA AND RIVER DIVERSION

Ashkhabad PROBLEMY OSVOYENIYA PUSTYN' in Russian No 3, 1980 pp 91-95

[Article by V. V. Barykina, I. A. Klyukanova, V. P. Kostyuchenko, and Ye. N. Minayeva, Institute of Geography of the USSR Academy of Sciences, received by editors 29 December 1979: "All-Union Workers Conference, 'Scientific Basis of Measures To Prevent Negative Consequences from a Drop of the Level of the Aral Sea' (26-28 November 1979, Moscow)"]

[Excerpts] The Third All-Union Workers Conference on Problems Connected with the Working Out of the Scientific Bases of Measures To Prevent Negative Consequences from a Drop in the Level of the Aral Sea took place in Moscow on 26-28 November in the Institute of Geography of the USSR Academy of Sciences.

The conference attracted more than 100 leading scientists and specialists of 40 organizations and institutions of the USSR Academy of Sciences and academies of union republics and planning and production organizations. Responsible associates of ministries and departments took an active part in the work of the conference.

Academician I. P. Gerasimov opened the conference. The report by I. P. Gerasimov, N. T. Kuznetsov, and M. Ye. Gorodetskaya (Institute of Geography of the USSR Academy of Sciences), "Urgent Tasks in Organizational Work on the Problem of the Aral Sea in Connection With the Decision of the Scientific and Technical Commission on the Territorial Redistribution of Water Resources and the Scientific Council, 'Integrated Use and Protection of Water Resources' of the GKNT [State Committee for Science and Technology]," summed up the basic results of studies on the problems of the Aral Sea and outlined long-range tasks.

In the report of N. P. Goptarev and V. N. Bortnik (GOIN) [State Institute of Oceanography], "The Contemporary Status and Possible Changes in the Hydrological-hydrochemical conditions of the Aral Sea," it was noted that the increase in the number of irretrievable withdrawals of flow and a number of dry years led to the disruption of the equilibrium state of the water and salt balances of the basin. The inflow of river water to the sea was reduced to 31.1 cubic kilometers per year (by 43 percent) for 1961-1978 as opposed to 56 cubic kilometers per year, the sea level dropped by 7 meters, from 53.0 meters absolute elevation in 1960 to its present level, that is, to an elevation of 46.2 absolute elevation, and mean salinity increased from 10.1 °/oo to 16.2 °/oo. The sea's hydrochemical conditions changed greatly. The drop in level will continue and by the year 2000 it is presumed that it will drop to 36.8 meters absolute elevation.

Concern for the difficult situation created in the Aral Sea basin as a result of the increase in activity in the development of irrigation agriculture was sounded in the report by I. B. Vol'ftsun, V. V. Sumarokova, and K. V. Tsypenko, "Anthropogenic Changes in River Flow Into the Aral Sea" (State Hydrological Institute). The total decrease in inflow into the Aral in 1971-1977 was 22.2 cubic kilometers per year, of which 17 cubic kilometers (77 percent) was under the influence of economic activity and 5.2 cubic kilometers, or 23 percent, under the influence of natural factors. The reduction in the rate of streamflow was accompanied by a deterioration of the quality of river water. In the lower reaches of the Syrdar'ya mineralization of the water increased more than three-fold (1.4-1.5 grams per liter) and in the lower course of the Amudar'ya it increased approximately 1.5-fold and reaches 0.6-0.8 grams per liter.

B. G. Shtepa, deputy minister of the USSR Ministry Land Reclamation and Water Resources, told about the tasks for developing water resources in the republics of Central Asia and Kazakhstan. Their implementation will simultaneously contribute to solution of the Aral Sea problem, too. In turn, the results of scientific studies should be considered in drawing up the General Plan for the Development of Water Resources and the special TED [technical and economic report] on the Aral Sea problem.

N. D. Beklemishev, academician of the Academy of Medical Sciences, Kazakh SSR, and member of the collegium of the USSR Ministry of Health, stressed that the work of this conference permits looking in a new manner at many problems whose solution urgently dictates the necessity for the expansion of medical-sanitary and medical-geographic studies within the framework of the problem and the use of their results in the practical activity of the corresponding institutions.

A. A. Yurits, deputy chairman of the Council of Ministers of the Kara-Kalpak ASSR, dwelled on the complexity of solving the problem where the natural history aspect is tied closely with the plans for the economic and social development of the Aral region. In particular, in the delta of the Amudar'ya the complexity of the problem's solution includes questions of preserving some traditional forms for the use of natural resources (fishing, muskrat raising, and so forth) under changed conditions.

I. A. Gerardi, deputy chief engineer of "Soyuzgiprovodkhoz" [All-Union State Planning, Surveying and Scientific Research Institute of Water Planning Construction], stressed the necessity to solve the problem of the Aral Sea in connection with and depending on the problem of the diversion of part of the water of the Siberian rivers to the Aral Sea basin.

The representative of the State Committee on Science and Technology of the USSR, V. I. Vinogradov, noted the importance of an independent solution to the problem of the Aral Sea independent of the problem of diverting Siberian rivers, which should speed up the introduction of the studies' results into practice.

The conference worked out a detailed decision, noted the comprehensiveness of the studies and the value of the materials obtained, and established the continuity and unity of approach to the Aral problem.

The materials of scientific studies which were presented at the conference provide grounds to consider that with the conduct of necessary additional studies it is completely possible and necessary to begin at once the working out and implementation of the main measures in the struggle against the processes of anthropogenic desert formation and control of the desication of the Aral Sea. Attention should be devoted to preparing a scientific and technical report on the reconstruction of the Aral basin and to hydraulic-engineering and land reclamation measures which are directed toward the radical improvement of water utilization in the delta regions of the Amudar'ya and Syrdar'ya.

Proceeding from the necessity to continue basic scientific studies on the problem under consideration in the 11th Five-Year Plan, work should be begun on drawing up a coordination plan of work on the Aral Sea problem for 1981-1985 with their inclusion in the work program on subject matter of the State Committee on Science and Technology. The new coordination plan should envision:

--continuation of the integrated basic scientific (geomorphological, soils, botanical, landscape, and others) studies of the process of anthropogenic desert formation which is occurring in the Aral region;

--the working out of scientific forecasts of the drop in level and increase in the mineralization of the Aral Sea waters in accordance with a refinement of the forecast of the water balance.

--studies on the change in hydrobiology and the hydrochemistry of the Aral Sea, on the settling of salts in residual basins of the Aral, on the dynamics of relief formation processes and the formation of the landscape of the new dry land, on the loss of salt and dust from the surface of the new dry land, and on forecasting the macro-, meso-, and microclimatic changes in Central Asia and the Aral region as a result of the Aral's degradation and the development of desert-formation processes;

--continuation of scientific studies on the hydrogeology of the Aral Sea basin for a differentiated estimate of the subsurface water in the direction of its economic use;

--continuation and deepening of studies of the problem's socioeconomic aspect;

--the conduct of various medical-sanitary studies.

6367
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REVIEW OF MONOGRAPH ON USSR RIVER SYSTEMS

Moscow VODNYYE RESURSY in Russian No 4, 1980 pp 194-195

[Review by A. Ye. Asarin and I. A. Terman of the book "Problemy preobrazovaniya rechnykh sistem SSSR" [Problems of Transforming USSR River Systems] by S. L. Vendrov, Leningrad, Gidrometeoizdat, 1979]

[Text] Somewhat paraphrasing the first paragraph of the "Conclusion" of the book under review, one can say that each stage in the development of a society has its own approach to the utilization of natural resources, particularly water resources.

Our times are characterized by a great concern for the fate of rivers and bodies of water, extensive raising of the problem of efficient and thrifty utilization of surface and ground waters, and by planning and scientific research work devoted to regulating the flow and territorial redistribution with simultaneous maintenance (or restoration) of the purity of the waters.

Concern for the future of our country's water resources pervades S. L. Vendrov's new monograph which is small, but filled with interesting information and significant thoughts. Almost every one of its 14 chapters deals with critical and certainly not easily solved (and sometimes even unsolvable in the foreseeable future) problems in the utilization and preservation of water resources.

It would hardly be expedient in a short review to try to present the book's content and deprive the reader of the opportunity to become familiar (and sometimes argue) with the views of S. L. Vendrov concerning such questions as the value and price of water resources, ways of improving the quality of water and the possibility of "closed" transportation of industrial wastes, the interrelations between rivers and seas, city agglomerates and water flows, interbasin diversion of streamflow and the fate of the donor rivers, and also the multitude of other problems that are related or arise by association.

At the same time, reading this book causes one to think and try to formulate one's own viewpoint regarding many of the problems touched upon by the author, and also to augment and refine some of the things that the author has not discussed fully.

Thus while sharing S. L. Vendrov's viewpoint concerning tasks of general and basin schemes for the utilization and protection of water resources, one cannot fully accept his demand for "numerous variants" of long-term plans for the

development of water resources. It is hardly necessary to consider a multitude of variants if one keeps in mind both the labor-intensiveness of working out several possible ways of developing and distributing water-intensive branches of the economy and the "inertia" of the economic life of the regions, which is related to natural conditions and the traditional specialization of the population. It is expedient to analyze several variants for the development of the economy, but the number of variants should be kept to a minimum.

There are also doubts about the author's suggestion to consider "groups of years that vary in terms of precipitation within the framework of 10 or 20 years." (p 39) It is apparently sufficient, as has been done up to this point, to orient oneself only toward the critical conditions: little precipitation in regions where there is a shortage of water and large amounts of precipitation in regions where there is an excess of it. After all, the withdrawal from the Ob' of 25 cubic kilometers of water to be diverted into the Aral Sea basin (including 10 cubic kilometers during the high water period) has an extremely insignificant effect on the conditions of flooding in the lowlands of the lower reaches of the river during years with a large or even a medium amount of precipitation.

At the same time, when speaking about accounting for the water factor in planning (especially long-term) the development and distribution of water-intensive branches of the national economy in regions whose water resources need to be augmented, one should apparently consider two ideas in equal detail. The first should be based on the utilization of the region's own water resources during the next few decades. Here the increase in water-intensive industries should be provided for through the implementation of measures that reduce the expenditure of water for the needs of existing water consumers. Among these measures one can include the reconstruction of irrigation systems, the creation of purification installations that prevent releasing waste waters for dilution, damming rivers, changing over from releasing water to flood lowland meadows to regular irrigation, diverting the water with pumps, and limiting or curtailing water-intensive industries, (for example, reducing the area of rice systems on the lower Syrdar'ya or Kuban') and so forth. The consideration of the first concept should culminate in conclusions concerning the maximum permissible development of water consumption, the ecological consequences of this development and suggestions concerning necessary water management measures within the basins and efficient direction of the development of the economy.

The second concept should be based on conditions which can arise after the beginning or in some stage of the diversion into the region under consideration of streamflow from other basins that have more water. Here one should consider changes in the specialization of the economy (for example, expansion of rice crop rotations in the lower reaches of the Syrdar'ya, the establishment and maintenance of the fish productivity of the bodies of water, and so forth).

The author is not the first to touch upon large water management problems which human society will not be able to resolve until the distant future. These include the movement of icebergs, the melting of masses of ice, the creation of extra long main canals that gather water from the depths of the ocean. Among the ideas which can be realized in the foreseeable future one can include the suggestion of creating circular canal collectors that surround bodies of drinking water

that are used at the present time or reserved for the future such as the Klyaz'minskoye water reservoir and Lake Sevan.

The book devotes a large amount of undoubtedly justified attention to today's situation in the fate of internal seas, particularly the Azov and Aral seas.

S. L. Vendrov seems to be correct in his opinion that when evaluating the future salinity and fish productivity of the Azov Sea it is hardly possible to count on an annual diversion of water from the Volga into the Don of about 20 cubic kilometers (on an average) and 30 cubic kilometers in certain years. The author sees the solution in economical expenditure of water resources of the Don and the Kuban' without mentioning the possibility of regulating the salinity of Azov water with the help of the hydraulic unit in the Kerch Straits.* Against the background of the endless debates of the proponents and the opponents of regulating installations in these straits, the author's well-reasoned opinion could tip the scales in one direction or another.

The information about predictions of the level of the Aral Sea and its current condition that is presented in the book under review needs some clarification. The first likely prediction based on the future fluctuations in the level of the sea was published in 1964 in the 12th issue of TRUDY GIDROPROYEKTA. Later the prediction was made somewhat more precise and announced in 1973 at the 4th All-Union Hydrometeorological Congress (the data from this report, which was not published until 1976, were used by S. L. Vendrov). By the end of 1979 the level of the Aral had reached the 46.0 meter mark, and the salinity of its water had increased to 16 percent, which is somewhat less than the amount predicted for this level. The movement of the level of the Aral Sea corresponds fairly well to the prognosis made by one of the authors of the present review in 1976 in an article entitled "Tasks of Scientific Research in the Area of the Future Water Balance and the Conditions of the Levels of the Aral Sea." TRUDY GIDROPROYEKTA, 1976, issue 53.

More than one-fourth of the book is devoted to the subject that interests S. L. Vendrov most--water reservoirs and their effects on the environment. It is curious to note that in the first edition of the monograph 4 out of 9 of its chapters were devoted to water reservoirs (90 out of 225 pages). While giving the author's persistent attention its due, one would like to become more familiar with his views on how to evaluate the effects of water management measures on the river system and the surrounding environment in the plans for large hydroelectric power stations, irrigation systems and interbasin diversion of streamflow.

It would not be a bad idea for S. L. Vendrov to develop his essential ideas about the organization of research for predicting the interactions of planned hydraulic engineering systems and the surrounding environment into a separate publication (he gives us information in an appendix at the end of the book).

*The misgivings expressed on page 133 that the Kerch hydroelectric complex would lead to a deterioration of the quality of Azov water (like the presupposition concerning the role of the dam in the Dnepro-Bug Estuary), in the opinion of the authors of the review, is debatable.

One of the most valuable elements of the book is its "conclusion," which formulates 14 contemporary "postulates" concerning the utilization of surface waters and their natural and improved condition, and concerning accounting for and comparing positive and negative consequences of redistributing water resources.

The architectonics of the book as a whole can be said to be successful as can the developed subheadings of the chapters with the exception of certain ones (for example, subheading 1.7 on page 66--"Increased requirements for durability of installations on rivers as a result of the seasonable and multiannual range of water expenditures").

The book under review will undoubtedly be useful to a continually expanding group of specialists--hydrologists, land reclamation workers, hydrotechnicians, power engineers, ecologists, economists and also nonprofessional readers who are interested in the current condition of the incipient science that deals with comprehensive and efficient utilization of water resources.

11772
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REPORT FROM SEPTEMBER 1979 CONFERENCE ON GROUND WATER IN EASTERN USSR

Moscow VODNYYE RESURSY in Russian No 4, 1980 pp 200-201

[Article by Ye. V. Pinneker and A. P. Khaustov: "All-Union Conference on Ground Waters in Eastern USSR"]

[Excerpts] The 4th conference on ground waters of Siberia and the Far East was held in Petropavlovsk-Kamchatskiy during 12-14 September 1979. It was organized by the Commission for the Study of Ground Waters of Siberia and the Far East of the SO AN SSSR (Siberian Branch of the USSR Academy of Sciences), the Kamchatskiy Territorial Geological Administration and the Institute of Volcanology of the DVNIs AN SSSR (Far Eastern Scientific Center of the USSR Academy of Sciences). The Kamchatskiy CPSU obkom and the VSEGINGEO (All-Union Scientific Research Institute of Hydrogeology and Engineering Geology) rendered a great deal of assistance in organizing and conducting it. After the conference there was a symposium entitled "Questions of Hydrogeology in Kamchatka."

It should be noted that the conference was very representative. Participating in it were 240 representatives of institutes of the AN SSSR (USSR Academy of Sciences) and the union republics, and scientific research institutes of various ministries of the USSR (geology, the petroleum and gas industry, nonferrous metallurgy), territorial geological administrations of the Mingeo RSFSR (RSFSR Ministry of Geology) and administrations of the union republics, many higher educational institutions of the country and also scientific research and design institutes and production organizations of various branches and departments.

The discussion and exchange of opinions on problems considered at the conference made it possible to develop a number of recommendations and goals to be desired in order to further intensify and improve the quality of hydrogeological work in the eastern part of the USSR. The main ones are given below.

1. To continue planned participation in investigation and prospecting for ground water for water supply in industry, transportation and agriculture, including facilities of the Baykal-Amur Mainline, the Kansk-Achinsk fuel and power complex and the Southern Yakutiya industrial complex as well as regions where petroleum and gas deposits are being assimilated in Western Siberia.

2. To participate actively in the consideration of the hydrogeological aspects of the problem of a possible diversion of part of the streamflow from Siberian rivers into Central Asia.

3. To expand further research for studying the hydrogeology of volcanic areas and areas of the shelf.

4. To increase the amount of attention paid to protection of the environment (including natural hydrothermal systems), particularly when solving the problem of disposing of used industrial waters.

5. To draw attention to the need for developing methodological recommendations (especially for the Kuril-Kamchatka-Sakhalin zone and the region of the BAM route) in order to study the hydrogeological indicators of the predictions of earthquakes and the methods of organizing test areas for these predictions.

6. In order to intensify work for assimilating the earth's heat for power purposes, to consider it necessary to step up prospecting work on the most important sources of thermal waters in Siberia and the Far East.

7. To request that the USSR Ministry of Geology accelerate the development and confirmation of methodological guidance regarding hydrogeological work at mineral deposits when they are prospecting, with mandatory observance of the rules for protection of the environment, and also to develop for territorial geological administrations methodological fundamentals for the organization of testing grounds for predictions (permanent) and a unified methodology of seismohydrogeological observations.

It was decided to convene the regular 10th conference on underground waters of Siberia and the Far East in 1982 (in Irkutsk or Tomsk). The Commission for the Study of Ground Water of Siberia and the Far East was instructed, in conjunction with the organizers of the future conference, to develop the subject matter, taking into account recommendations that were made at this conference.

11772
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RIVER DIVERSION NOT SOLUTION FOR ARAL SEA PROBLEM

Ashkhabad PROBLEMY OSVOYENIYA PUSTYN' in Russian No 5, 1980 pp 10-17

[Article by N. T. Kuznetsov, Institute of Geography, USSR Academy of Sciences: "Preliminary Results and Some Directions for Further Research on the Problem of the Aral Sea"]

[Excerpts] The numerous complex studies of the Aral Sea carried out in the last 3-4 years have touched all basic aspects of the problem: the hydrological and hydrobiological regimes of the sea, its ecosystem, condition and change of the natural environment in the area near the Aral Sea and the socioeconomic consequences of the lowering of the water level in the Aral Sea.

It is difficult to overestimate the role of the published results of studies,* since even until recently among individual specialists, generally hydro-agriculturalists and reclamationists, there still exists an incorrect idea about the essence of the Aral Sea problem, its future and its relationship to the problem of diverting part of the flow of Siberian rivers channels into the Aral Sea basin. The lack of understanding and consequently the given underestimations of the Aral problem are related to the fact that the basically incorrect position of trying to preserve the Aral Sea exactly in the form that it had up to 1960 is often attributed to those who support a constructive solution to the Aral Sea problem. Actually this approach was already excluded in the beginning of the work on this problem and the discussions focused on how to substitute for the gradual drying-up of the Aral Sea some control of this process by several means and among these, measures suggested by leading scientists for retaining the flow of a greater part of the river waters already used for agriculture (including waste waters and waters of sanitation outlets along the Amudar'ya and Syrdar'ya Rivers) into the Aral, and the division of the Aral into several bodies of water. The main objective of these measures is the preservation of the flow and salinity in these bodies of water such that salt-tolerant fauna and flora could exist in them.

*Publications in the journals PROBLEMY OSVOYENIYA PUSTYN', IZVESTIYA AN SSSR, SERIYA GEOGRAFICHESKAYA and VODNYYE RESURSY allow us to concentrate not on the factual results of the works but on some generalizations which can be drawn from this information. Therefore, the bibliography lists only articles which examine directions and methods of research. In addition, we note institutes and organizations which are participating or which can participate in the solution of the Aral Sea problem.

The control of the Aral Sea regime is important but it is not the only element of the problem--its importance is related to the unavoidable undesirable changes in the natural environment of the area near the Aral Sea which would result from a declining sea level and the socioeconomic consequences of such a decline. It is precisely this element which was taken as the basis of the solution of this problem, when the major objective of research efforts was directed at finding scientific justification for measures to be taken to alleviate the undesirable ecological and socioeconomic consequences of a lowered sea level.

The content of the Aral Sea problem predetermined the objectives of research: the actual body of water, the natural environment of the Aral Sea area, the drying-up of the sea bottom and the socioeconomic consequences of a declining level of the Aral Sea.

As is known, the diversion of part of the flow of Siberian rivers into the Aral Sea basin has its own problems and follows certain objectives in that the diversion is intended to increase water resources and thus in a wider and more varied way use the high natural potential of Central Asia and Kazakhstan, primarily their soil and climatic resources. In addition, the diversion of part of the flow of Siberian rivers allows us to decrease, and in certain cases even perhaps eliminate undesirable ecological and socioeconomic consequences of the declining Aral Sea level. Actually, using only the given resources of the Aral Sea basin under optimal conditions the platform of reserve water will barely be greater than 12,000-15,000 km^2 and the gravitational field will be approximately in the vicinity of 28-29 m abs. Preliminary investigations by the State Hydrological Institute indicate that a diversion of 25 km^3 per year of Siberian river waters will give return waters (including the analogous category of Central Asian waters) of approximately 22 km^3 per year. In order to insure the supply of these waters to the Aral Sea, its platform will be 25,000-26,000 km^2 and the gravitational field approximately 34.0 m abs. There also exists the possibility of a more complete regulation of the regime and a structure of the anthropogenic water source such that the platform of the sandy-salty desert now being formed on the dried-out sea bottom would be decreased and combined into the total unit of Karakuma and Kyzylkuma.

Let us recall that research on the socioeconomic aspects of the Aral Sea problem when compared to the ecological problems, started somewhat belatedly and therefore studies on the socioeconomic consequences of the declining sea level in the Kazakhstan section of the Aral Sea area are not as conclusive as those for the Uzbek part. However, the preliminary results related to the socioeconomic problem of the northern Aral area are echoed in the studies of the Geographic Sector of the AN KazSSR [Academy of Sciences of the Kazakh SSR].

The extraordinarily important point in socioeconomic studies on the Aral Sea problem is related to the fact that representatives of the Council of Ministers of the Karakalpak ASSR and of the Kyzyl-Ordinskyy oblispolkom take an active part in them and present their views on the socioeconomic consequences of a declining Aral Sea level. Some of these data have been published.[6] It should be especially emphasized that all studies of this type include proposals on restructuring agriculture, on developing fishing, on the implementation of other new forms of utilizing natural resources according to the changing conditions of the natural environment. The necessity of such changes in the national economy was already

predicted in the beginning of the studies on the Aral Sea problem,[3] but it found a concrete form only in the work-ups related to the study of the socioeconomic consequences of a lowered sea level.

The availability of wide and varied information on the state and the changes in the Aral Sea ecosystem, on the environment of the Aral Sea area, which 3-4 years ago was even unthought of, should be considered the basic and most important result of the studies on the Aral Sea problem. This is also related to the solution of such problems as the development of scientific bases of measures for alleviating the negative consequences of a lowered Aral Sea level and the establishment of directions for new studies in the near future as well as in the 11th Five-Year Plan.

The scientific bases of measures directed toward an alleviation of the undesirable consequences of a declined Aral Sea level as well as the measures themselves are found in the work of all organizations and institutes participating in the solution of the Aral Sea problem. The proposals can be classified into two major groups: measures being taken or to be taken which are not directly related to the decline in the Aral Sea level, and measures whose implementation is a direct response to the declining sea level.

The measures of the first group are very diverse but among them a special place is held by the proposal of the Council for the Study of Productive Resources of the Academy of Sciences of the UzSSR on the implementation of corrections and future plans for the economic and social development of the republics of Central Asia and Kazakhstan in order to avoid possible nonfulfillment of the long-term strategic goals of their development brought about by the decline in the sea's level. These studies often take into account measures already being taken in ordering water requirements in the Aral Sea basin and include scientifically based studies of irrigation and washing norms and the increased KPD [efficiency factor] of irrigation systems, etc.

Proposals on the accelerated determination of ground water resources and an explanation of the possibilities for their use (taking into account the working of aquifers as well as naturally renewable resources) in agricultural production and especially in the drinking water supply of the lower part of the Syrdar'ya and the Amudar'ya.

In compensation for lost meadows and pastures which would result during the liquidation of natural flood plains in the beds of these rivers, measures are proposed which would give a constant nourishment base by means of phytomelioration as well as by an increase in the release of river waters to maintain the productivity of the natural and generally tugaic vegetation.

A program of measures on the preservation of the natural environment and natural resources should be developed. Such a program and its implementation under conditions of a changing environment (for example, the introduction of more salt-tolerant and less moisture-loving cultures in farming) should foresee the creation of national forests and preserves with the purpose of preserving the desert genofund. Within the framework of such a program there should also obviously be some monitoring of the environment.

Special attention in the system of proposed measures is given to the control of fulfilling the general scheme of the complex use of the water resources of the Aral basin. In transferring to an automated system of water distribution and water use, to the existence of capital plans and the rebuilding of irrigation systems with repeated water use in rice cultivation, it is expected that the undesirable effect of the anthropogenic desertification in the Karakalpak ASSR and in the Khorezm will be alleviated. This does not exclude the possibility of a low pressure (shielding) dam in the river bed of the Amudar'ya delta to prevent a deepening of the river bed and a lowering of ground water, and, therefore, a desertification and transformation of the delta into a desert. Preserving the tugaic pastures, the dam will simultaneously permit the creation of reservoir fisheries in the delta lakes. Such is the far from complete cross-section of measures which will enable us to alleviate the undesirable consequences of a declining sea level in the Aral together with a general reconstruction of the water management of Central Asia and Kazakhstan.

Of the measures directly addressed to the liquidation or alleviation of such consequences of special significance still today are the unrealized proposals on letting the greatest possible amount of drainage, waste water and water already otherwise used in national economy flowing into the Aral Sea. The implementation of these measures will not only decrease the rate at which the sea level falls but can also stabilize it in the future at a fairly high level. The need for such measures is determined by the fact that the higher the sea's level at which it is stabilized, the fewer the undesirable ecological changes and socioeconomic consequences of the sea's decline. The solution of this problem will also be facilitated by measures concerned with dividing the sea. Several schemes for such a division have been proposed. They would provide control by a system [consisting of] the reservoirs which would exist in place of a single sea. Differences among the schemes are generally found in determining which aquatoria are to be preserved. There are three variants in all: the preservation of the Maloye Sea and the western, deeper part of the Bol'shoye Sea, the preservation of the Maloye Sea and the eastern part of the Bol'shoye Sea, and finally, the preservation of its eastern part only. All schemes foresee the construction of earth dams and mechanisms for releasing water to insure flow in the reservoirs.

Proposals to control the system of the Aral Sea by separating it into several parts are part of a larger system of measures intended to decrease the ecological and socioeconomic consequences of a declining sea level. The materials in this plan will soon enable us to formulate TED [technical and economic reports] on the Aral Sea problem which should also be considered a most important result of the studies conducted. In the technical and economic report it is proposed to include measures which will be established as a result of completing the second half of the program of study, namely, the prognosis for future environmental changes in the Aral Sea area. According to the plan, these studies should be completed in the current 5-year plan. Fragments of such predictions are already present in much completed work. Therefore it can be assumed that in this area the problem will be solved as planned.

It was noted above that this article does not intend to give an exhaustive analysis of the state of the art and research perspectives on the Aral Sea problem, but it examines only obvious questions and problems. In addition, some of the

evaluations may be subjective. Nevertheless, general conclusions can be drawn from the above.

Environmental changes in the Aral Sea area, the establishment of natural complexes on the dried-out sea bottom and the resulting scientific-technical measures should be seen as factors which already to some degree determine and which to a significant degree will determine the future ecological, economic and social situation in the Aral region.

Many studies on the Aral Sea problem are in the realm of investigations within the framework of fundamental studies in geography. Therefore, as in any investigation, it is not always possible to obtain the desired results immediately, especially in the prediction of environmental changes and socioeconomic consequences of a declining Aral Sea level. Accomplishments in this area will be more significant if the ecological results will be tightly bound with the socioeconomic aspects of the problem. This does not exclude the possibility that sometimes these problems may contradict ecological ones. For example, the latter require perhaps a greater flow of water into the Aral Sea, while economic interests are related to the repeated use of mineralized, recycled and drainage water for irrigation and the leaching of the soil. Finally, in spite of the specifics of the anthropogenic desertification of the Aral Sea area, ecological and socioeconomic results of the studies of this process may have a real input in solving global problems of desertification.

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SEVENTH CONGRESS OF USSR GEOGRAPHERS CONSIDERS RIVER DIVERSION

Ashkhabad PROBLEMY OSVOYENIYA PUSTYN' in Russian No 6, 1980 p 93

[Article by N. O. Nazarov and M. Khudayyarov: "Seventh Congress of USSR Geographic Society, 22-27 September 1980, Frunze"; received by editors 13 October 1980]

[Text] The Seventh Congress of the USSR Geographic Society opened with introductory remarks by the society's president, A. F. Treshnikov.

Attending the congress were members of the Bureau Central Committee of the Kirghiz Communist Party and members of the Kirghiz SSR government, distinguished people of the republic, numerous guests, delegation leaders from republic geographic societies, branches, and sections, and participating in the work of the congress was the delegation of the Turkmen SSR headed by the chairman of the TGO [Turkmen Geographic Society], corresponding member of the Academy of Sciences of the USSR, A. G. Babayev.

Altogether, there were more than 800 delegates and 300 guests. The congress heard the summary report of the society's Scientific Council and Presidium for the years 1975-1980 and discussed more than 250 reports and about 200 display communications at plenary sessions, and more than 150 people spoke in discussions on the reports and communications.

The congress' main work and that of its leading sections took place in the House for Political Education of the Kirghiz Communist Party Central Committee and on the campus of the Kirghiz State University.

The plenary sessions heard the main report of the congress by A. F. Treshnikov, V. S. Zhekulin, S. B. Lavrov, V. S. Preobrazhenskiy, K. A. Salishchev, and A. M. Ryabchikov: "Main Trends in the Development of Geography in the Era of Developed Socialism" and the problem reports of the country's leading geographers: I. P. Gerasimov's "Scientific Ideology of Constructive Geography," "Geography's Tasks in Connection With the Improvement of National Economic Planning" of N. T. Agafonov, E. B. Alayev, M. M. Palamarchuk, and B. S. Khorev, and others.

Special interest was caused by the report of Academician A. G. Aganbegyan, "Problems in the Development and Disposition of Siberia's Productive Forces," which presented interesting material on the scientific planning of the development of territorial-production complex (TPK) based on the natural, basically geological, resources of individual regions.

The work of the congress took place in eight sections: "Geographic bases for the formation of national-economic complexes and settlement systems"; "Geographic studies for purposes of socialist utilization of nature"; "Contemporary problems in studying the world ocean"; "Aerospace and cartographic methods in studying the environment"; "Interbasin redistribution of water resources and its effect on natural conditions and the national economy"; "Problems of combined geographic study and the development of mountain territories"; "Improving the teaching of geography in the secondary and higher school"; and "Ways to increase the effectiveness and quality in propagandizing geographic knowledge"; and in 13 subsections.

The works of the congress were continued in symposia conducted in the capitals of the Central Asian union republics--Ashkhabad, Dushanbe, Tashkent, and Frunze, and were devoted to geographic study and its effect on the development of the economy and national-economic planning.

Elections of the Scientific Council, presidium, and Soviet and foreign honorary members of the USSR Geographic Society took place at the concluding session of the congress.

Corresponding member of the Academy of Sciences of the USSR, director of the Institute for the Arctic and Antarctic of the Academy of Sciences of the USSR, and an important scientist, geographer A. F. Treshnikov, was again elected president of the USSR Geographic Society.

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COLLECTION OF ARTICLES ON REVERSAL OF NORTHERN RIVERS

Leningrad PROBLEMY ARKTIKI I ANTARKTIKI in Russian No 55, 1980 (signed to press 27 Aug 80) pp 3, 5, 135-138

[Table of contents, introduction and abstracts from collection "Problems of the Arctic and Antarctica," Arkticheskiy i Antarkticheskiy Nauchno-Issledovatel'skiy Institut, 138 pages]

[Excerpts] Table of Contents

Introduction. The articles published in this collection for the most part reflect the content of reports presented and discussed at the All-Union Conference on Evaluation of Possible Changes in the Regime of the Lower Reaches and Mouths of Rivers in the Arctic Zone of Western Siberia Under the Influence of Water Management Measures held at the Arctic and Antartic Scientific Research Institute during the period 16-18 November 1976.

The collection of articles is opened by A. F. Treshnikov and V. V. Ivanov, who give a concise review of investigations for evaluating the possible changes in natural conditions of the mouth regions of rivers and seas of the arctic zone under the influence of the diversion of streamflow.

The articles by V. S. Antonov, V. V. Ivanov, Yu. V. Nalimov, R. V. Donchenko, N. I. Makkaveyev, V. N. Korotayev and R. S. Chalov give an analysis of the present status of the hydrological and channel regimes of the lower reaches and mouths of rivers. The articles give the preliminary results of evaluation of possible changes in the hydrological regime of the lower reaches and mouths of the Ob', and also suggest approaches to further investigations.

The article by V. M. Smagin, V. P. Rusanov and I. M. Katunin examines individual problems in evaluating the possible changes in the hydrochemical regime and an article by Ye. G. Nikiforov, V. N. Moretskiy and A. O. Shpaykher is devoted to the patterns of the hydrological regime of the Arctic Ocean and gives the possible tendencies in their changes as a result of withdrawal of part of the flow of Siberian rivers.

The next group of articles (O. A. Drozdov, O. G. Sorochan, L. P. Burov, A. I. Voskresenskiy, S. M. Novikov, A. S. Dubov, I. N. Zav'yalov, Z. M. Utin, L. A. Gavrilov, V. N. Malinin, N. P. Smirnov) contains information from investigation of the elements of the water and heat balance of the "hydrosphere of the land-atmosphere" system in the lower reaches of the Ob' under the influence of economic measures. The influence of regulation of the flow of the Ob' on change in regional climate is considered.

The concluding articles are devoted to the influence of changes in the channel regime on navigation conditions (N. A. Khakhin and S. G. Shatayeva) and characterize fishing (O. P. Novitskiy and S. N. Katkov) in the lower reaches of the Ob' under the conditions of the proposed withdrawal of part of the flow.

Candidate of Technical Sciences V. V. Ivanov was the scientific editor of the collection.

ABSTRACTS (PARTIAL)

UDC 556.5(98)

LONG-TERM FLUCTUATIONS OF INDIVIDUAL ELEMENTS OF THE HYDROMETEOROLOGICAL REGIME OF THE ARCTIC

[Abstract of article by Antonov, V. S.]

[Text] The long-term fluctuations of different aspects of the climate of the Arctic are considered. In the example of a long series of observations of the extent of ice cover of the Barents Sea it is possible to detect the existence of cyclic development of all natural processes in this extensive region. In general climatic development of the nature of the Arctic the dominant role is played by fluctuations of the inflow of relatively warm Atlantic waters into the Arctic Ocean. The principal reason for the cyclicity is autooscillatory planetary processes ensuring an equilibrium of the nature of the earth in the modern geological period. Figures 1, references 6.

UDC 556.535.4/5 556.048

POSSIBLE CHANGES IN THE ICE-THERMAL REGIME OF THE LOWER REACHES OF THE OB' RIVER WITH EXTRACTION OF PART OF ITS FLOW

[Abstract of article by Donchenko, R. V.]

[Text] A study was made of possible changes in the ice thermal regime of the lower reaches of the Ob' obtained by a comparison of its characteristics with those computed for conditions of a decrease in the liquid flow of the river. An attempt is made to determine the approximate changes in water temperature, times and duration of the period of freezing, setting-in of ice and breaking-up of the river. References 6.

UDC 556.54.535.4/5+556.048

CHANGE IN ICE CONDITIONS IN THE MOUTH REGION OF THE OB' AFTER DIVERSION OF PART OF THE WATERS INTO CENTRAL ASIA

[Abstract of article by Nalimov, Yu. V.]

[Text] The author examines the possible changes in the ice-thermal regime of the mouth region of the Ob' during the autumn, winter and spring periods as a result of withdrawal of part of the flow of Ob' waters. The changes in the regimes of formation, setting-in and growth of ice were evaluated by a comparison of its characteristics with the corresponding change in the liquid and thermal flow and also with the sum of negative air temperatures during the period of cooling of water and growth of ice. Changes in the regime of spring destruction of the ice cover were determined using the heat balance equation. References 7.

UDC 551.482.6

RESULTS OF AN INVESTIGATION OF CHANNEL PROCESSES AT THE MOUTHS OF THE PUR, TAZ, YAN AND INDIGIRKA RIVERS

[Abstract of article by Makkaveyev, N. I., Korotayev, V. N., and Chalov, R. S.]

[Text] The article gives a summary of the results of long-term investigations of the geomorphology, hydrological regime and mechanism of delta formation of the Taz, Pur, Yan and Indigirka Rivers. Generalizing data are given on the dynamics of water masses, transport and accumulation of sediments in the deltas of the enumerated rivers. It was possible to determine the principal patterns of formation of delta plains, the reasons for deformations of mouth bars and the nature of channel reformations. The authors give the principles for the formulation of measures for improving navigational conditions at the mouths of rivers. References 23.

UDC 551.464.3(268.52)

HYDROCHEMICAL REGIME AND CONSERVATION OF WATERS IN THE LOWER REACHES AND AT THE MOUTHS OF RIVERS IN WESTERN SIBERIA AND THE KARA SEA IN RELATION TO THE TERRITORIAL REDISTRIBUTION OF WATER RESOURCES

[Article by Smagin, V. M., Rusanov, V. P., Katunin, I. M.]

[Text] The authors have established the principal criteria characterizing the chemical state of water bodies, whose change can be reflected first of all in the bioproductivity of waters and their sanitary state under the influence of the planned territorial redistribution of water resources in the region. The extent of study of the hydrochemical regime of the Ob'-Taz Bay and Kara Sea in different seasons is considered. Also proposed is a complex of scientific and expeditionary investigations which will make possible the formulation of scientific criteria for determining the admissible withdrawals of flow and formulation of recommendations on prevention of the harmful effects on the hydrochemical regime of the region of diversion of part of the river flow. References 12.

UDC 551.46(268)+556.16(282.256)

VARIABILITY OF THE HYDROLOGICAL REGIME OF THE ARCTIC OCEAN AND PROBLEMS ARISING IN RELATION TO THE DIVERSION OF PART OF THE FLOW OF RIVERS OF ITS BASIN

[Abstract of article by Nikiforov, Ye. G., Moretskiy, V. N., and Shpaykher, A.O.]

[Text] The article discusses the principal patterns of formation of the present-day hydrological regime of the Arctic Ocean and possible tendencies in its change as a result of withdrawal of part of the flow of Siberian rivers. Figures 4, tables 2, references 19.

UDC 551.577.6+556.162(288.256.1)

POSSIBLE CHANGES IN ELEMENTS OF THE METEOROLOGICAL BRANCH OF THE HYDROLOGICAL CYCLE IN THE LOWER REACHES OF THE OB' UNDER THE INFLUENCE OF THE REDISTRIBUTION OF STREAMFLOW

[Abstract of article by Drozdov, O. A., Sorochan, O. G., Burova, L. P., and Voskresenskiy, A. I.]

[Text] A study was made of the relationship of air temperature at arctic stations and the conditions of formation of precipitation anomalies in the Central region and the European USSR. It was established that the proposed change in the thermal regime of the Kara Sea as a result of diversion of part of the flow from the Ob' and Yenisey with an increase in the ice content of arctic seas will create favorable conditions for the moistening regime of arid regions. Also shown is the role of the stimulating effect of additional evaporation in the southern part of the European USSR and in Central Asia in the processes of formation of precipitation, including precipitation in the subarctic zone. A study was made of the elements of the water balance of the "hydrosphere of the land-atmosphere" system in the lower reaches of the Ob' in years with a natural decrease in runoff close to the planned withdrawal. Tables 1, references 12.

UDC 556.56:330.007

POSSIBLE CHANGES IN THE WATER-HEAT REGIME OF SWAMPS IN THE FAR NORTH OF THE WEST SIBERIAN PLAIN UNDER THE INFLUENCE OF ECONOMIC ACTIVITY

[Abstract of article by Novikov, S. M.]

[Text] On the basis of materials of expeditionary investigations carried out at the State Hydrological Institute in the swampy territories of the West Siberian Plain the author expresses some ideas concerning the possible transformations of the water-heat regime of swampy landscapes in the Far North under the influence of economic measures. Also presented is a methodological approach to study of extensive swampy territories and the problems facing specialists working on the problem of evaluating the influence of economic activity on the natural conditions of the Far North. Figures 1, tables 2, references 10.

UDC 551.588.7

PROBLEMS AND METHODS FOR INVESTIGATIONS OF THE METEOROLOGICAL REGIME OF THE ARCTIC ZONE OF WESTERN SIBERIA IN RELATION TO THE TERRITORIAL REDISTRIBUTION OF WATER RESOURCES

[Abstract of article by Dubov, A. S., Zav'yalova, I. N., Utina, Z. M.]

[Text] The authors examine the extent of study of the meteorological regime of the region of the Ob'-Yenisey North and also specific problems associated with the possible consequences of impending meliorative measures in Western Siberia, methods for their evaluation and the problems involved in further investigations of the meteorological regime in this region. Figures 1, references 30.

UDC 551.588.7(571.12)

POSSIBLE CHANGES IN CLIMATE IN THE REGIONS OF THE OB' NORTH UNDER THE INFLUENCE OF WATER MANAGEMENT MEASURES

[Abstract of article by Gavrilova, L. A.]

[Text] A study was made of the influence of regulation of the flow of the Ob' on change in regional climate. Semiempirical and physicostatistical models can be used in a quantitative evaluation of the change. The article examines approaches to their creation. It is postulated that regional changes in climate can be blocked by a change in the intensity of circulation in the temperate latitudes as a result of an increase or decrease in the ice content of the Kara Sea. Figures 1, tables 1, references 20.

UDC 551.579

SOME PROBLEMS IN STUDY OF THE ATMOSPHERIC BRANCH OF THE HYDROLOGICAL CYCLE OF THE NORTH POLAR REGION

[Abstract of article by Malinin, V. N., and Smirnov, N. P.]

[Text] The article gives maps of macroturbulent and total meridional flows of water vapor over the Arctic during January, July and as an average for the year. The authors have computed the mean monthly values of divergence of moisture due to different types of meridional movement over the Arctic Ocean. An estimate of the divergence of the flow of water mass for the Arctic Ocean is given. The principal problems in study of the water balance of the Arctic are discussed. Figures 4, tables 1, references 26.

UDC 556.18+639.2(282.256.1)

IMPORTANCE OF THE LOWER REACHES AND MOUTH REGION OF THE OB' FOR FISHING AND THE POSSIBLE INFLUENCE OF WATER MANAGEMENT MEASURES ON ITS FISH PRODUCTIVITY

[Abstract of article by Novitskiy, O. P., and Katkov, S. N.]

[Text] The importance of the water bodies of the Ob'-Irtysh basin for fishing is determined by the nature of river flow, thermal and biogenous runoff, arriving from the southern regions of the basin. A reduction in the volume of the flow of the Ob' in connection with its partial removal for diversion to the southern slope can exert a substantial influence on fishing in the basin. References 12.

[99-5303]

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PROBLEMS IN STUDY OF THE NATURE OF THE ARCTIC IN RELATION TO THE PARTIAL WITHDRAWAL OF FLOW FROM SIBERIAN RIVERS

Leningrad PROBLEMY ARKTIKI I ANTARKTIKI in Russian No 55, 1980 (signed to press 27 Aug 80) pp 6-12

[Article by A. F. Treshnikov and V. V. Ivanov]

[Excerpts] In the scientific validation of the volumes and sequence of work on the territorial redistribution of water resources a considerable place is occupied by investigations for evaluating the possible changes in natural conditions of arctic regions, especially the ice, hydrological, hydrochemical and meteorological regimes, and also the geomorphological processes in the lower reaches and mouth regions of rivers and seas in the arctic zone. These investigations should be the basis for formulating recommendations on the maximum forestalling of the negative influence of the territorial redistribution of water resources on regimes and cesses in the mouth regions of rivers and seas of the arctic zone and the determination of the maximum admissible removals of the flow of northern and Siberian rivers from the point of view of preserving the environment and the prospects for developing the national economy in the Arctic.

During recent years such studies have been initiated through the joint efforts of the institutes and organizations of the USSR State Committee on Hydrometeorology, USSR Academy of Sciences, USSR Water Management Ministry, Ministries of Higher Education of the USSR and the RSFSR and other union and republic ministries and departments. However, due to the poor study of natural conditions in the Arctic, until recently there has been a study only of the present status of the regime elements and processes and only recently have computation and modeling methods been developed.

Particular attention is devoted to an investigation of the lower reaches and mouth regions of the Ob' and Yenisey Rivers, where the most significant changes in natural conditions are anticipated as a result of the partial withdrawal and regulation of flow. ["Evaluation of Possible Changes in the Regime of the Lower Reaches and Mouths of Rivers in the Arctic Zone of Western Siberia Under the Influence of Water Management Measures," TEZISY DOKLADOV (Summaries of Reports), Leningrad, 1976, 112 pages. AANII Reproduction Office.]

Evaluations of possible changes in the hydrological regime of mouth regions of rivers in the Arctic zone have been made only on the basis of a knowledge of the general patterns of hydrological processes at the mouths of rivers and have a

preliminary character. According to these evaluations the partial withdrawal of flow in a general case will bring a change in the hydrological regime of the mouth regions of rivers: lengthening of zones of propagation of the backwaters from the sea and an increase in the role of surge-type level fluctuations in the mouth reaches of rivers, deeper penetration of saline sea waters along the length of mouth embayments, decrease in the thermal flow of rivers, change in the position of zones with the greatest thicknesses of ice in mouth embayments, decrease in zones of thawing of mouth embayments in the spring under the influence of the heat of river waters and later clearing of the ice in the mouth regions of rivers in general.

In order to make a quantitative evaluation of the consequences of partial removal of streamflow, during recent years specialists at the Arctic and Antarctic Scientific Research Institute have developed and improved numerical methods for evaluating some elements of the hydrological regime. These include methods for making hydraulic computations and mathematical modeling of the water regime in the multi-distributary deltas of rivers, as well as methods for the mathematical modeling of the dynamics of flows and contaminations, represented by the ionic components of the water solution at mouth embayments.

In order to evaluate the change in hydraulic-morphometric characteristics of channels and multi-distributary deltas of rivers, specialists at the Leningrad Polytechnic Institute, in collaboration with specialists of the Arctic and Antarctic Scientific Research Institute, have proceeded to the development of a method for computing the distribution of water discharges through the delta arms with channel processes taken into account.

Different numerical methods for computations and modeling of the dynamics of waters and the propagation of sea waters into the river applicable to the mouth regions of Siberian rivers are also being developed at the Institute of Hydrodynamics Siberian Department USSR Academy of Sciences, Institute of Water Problems USSR Academy of Sciences, Leningrad Hydrometeorological Institute and the Leningrad Polytechnic Institute. We should especially note the work of the Institute of Hydrodynamics Siberian Department USSR Academy of Sciences, which has already found practical application in investigating the dynamics of waters of real river mouth features.

For evaluating the change in ice conditions at the mouths of rivers, specialists at the Arctic and Antarctic Scientific Research Institute, on the basis of the heat balance method, have developed a method for computing the boundaries of the thawing of ice and the duration of the period of clearing of ice from mouth embayments. A method for computing the autumn cooling of waters in mouth embayments is now being developed at the Leningrad Hydrometeorological Institute.

An individual problem in study of the nature of the mouth regions of rivers in the arctic zone, closely associated with their hydrological regime, is an evaluation of the change in geomorphological (channel) processes under the influence of both partial extraction and regulation of flow and the present-day complex of hydroengineering work carried out directly in the mouth regions of rivers (dredging and straightening of channels, hydroengineering construction, laying of pipelines).

Investigations of channel processes in the mouth regions of the rivers of Siberia are now being made at the Arctic and Antarctic Scientific Research Institute, Moscow State University, Leningrad State University, Leningrad Polytechnic Institute and the Leningrad Institute of Water Transportation. We should especially mention geomorphological investigations at the mouths of Siberian rivers carried out by the Laboratory of Soil Erosion and Channel Processes at Moscow State University. However, despite the collective efforts undertaken, there are still few data on the balance of sediments in deltas and in the mouth embayments of the Ob' and Yenisey, the lithodynamics of their shores, the tendency in the development of the hydrographic network, the dynamics of mouth bars, the influence of permafrost on the formation of channel relief. As a result, at the present time it is possible to give only qualitative evaluations of the influence of partial removal of streamflow on geomorphological processes at the mouths of rivers, which is expressed, in particular, in a change in the regime of accumulation of sediments, the dying out of secondary arms of deltas, changes in the hydrological-morphological characteristics of bars, sandbanks and shores.

For the successful and reliable prediction of possible changes in the natural conditions of the mouth regions of rivers in the arctic zone of Siberia there must be a substantial broadening of the theoretical, experimental and expeditionary investigations of the hydrological regime and geomorphological processes in these regions, devoting special attention to study of the regime and processes in deltas and the zone of active interaction of river and sea waters in mouth embayments.

These multisided investigations in the mouth regions of rivers in the arctic zone of Siberia should be accompanied by the establishment of specialized mouth hydrometeorological observatories (stations) with a network of automated posts and expeditionary subdivisions for work at permanently operating installations in deltas and at reference sections at mouth embayments. In particular, such hydrometeorological observatories must be created in the mouth regions of the Ob' and Yenisey Rivers, which will make it possible to obtain initial data for evaluations of possible regime changes in connection with the territorial redistribution of water resources, and also to organize monitoring of changes in the natural conditions in mouth regions of rivers under the influence of economic activity.

The change in the ice-hydrological regime of arctic seas under the influence of the partial removal of flow will be dependent, in particular, on the degree of change in the fresh-water balance caused by the removal and regulation of the flowof northern and Siberian rivers.

The investigations of the water balance of the Arctic Ocean made during recent years at the Arctic and Antarctic Scientific Research Institute have indicated that a positive fresh-water balance is one of the principal causes of water and ice exchange between the Arctic basin and arctic seas and adjacent basins. A change in the fresh-water balance of arctic seas can lead to a change in the thermal and dynamic state of water and ice in the sea and also will exert an influence on atmospheric processes in the region.

With the planned removal of water in the first stage (25 km^3 of water annually) for the variant of removal of water from the Ob' River at Belogor'ye the greatest changes must be expected in the hydrological and hydrochemical regimes of the mouth region of the Ob', primarily as a result of a considerable decrease in streamflow during the autumn-winter period and changes in its physicochemical characteristics. At the same time, substantial changes in the ice-hydrological regime of arctic seas, and also in the meteorological regime of the region as a whole are not expected from the measures taken in the first stage.

However, these conclusions are strictly preliminary, to a considerable degree have a hypothetical character and do not take into account other possible planning variants for the diversion of flow, which requires the carrying out of broad and more thorough investigations. At the same time, it must be noted that up to the present time there have been no significant investigations for formulating scientific criteria for determining the maximum admissible volumes of diversion of the flow of Siberian and northern rivers, taking into account the ecological, physiographic and socioeconomic consequences for arctic regions.

In the coming years it is necessary to carry out a great volume of scientific research, expeditionary and experimental work in the mouth regions of rivers and seas of the arctic zone for solving problems involved in evaluating the consequences of diversion of the flow on the natural conditions of the Arctic.

In particular, in the coming years it is necessary to carry out step-by-step work on scientific predictions of the influence of specific variants of the diversion of flow in the first stage, determine the maximum admissible removals of flow of northern and Siberian rivers and formulate recommendations on the prevention of the possible consequences of these measures on the environment and economic activity in the Arctic. These evaluations and recommendations must be based on a methodological foundation, taking into account the effect of constant removal of flow on natural processes, the presence of feedbacks in these processes, and also the predicted trends in the change of global climate under the influence of natural and anthropogenic factors.

In addition, at the same time it is necessary to begin the development of measures for creating an automated network of hydrometeorological observations for monitoring the change in the state of the environment and routine hydrometeorological support of the national economy in the arctic regions, and also recommendations on the creation of new methods for hydrometeorological predictions suitable for use under the modified natural conditions of the Arctic.

Work on such a scale can be accomplished with the combining of efforts of a wide range of scientific research and planning organizations with the involvement of all the interested ministries and departments.

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HYDROLOGICAL REGIME OF THE LOWER REACHES AND MOUTHS OF RIVERS IN WESTERN SIBERIA AND THE PROBLEM OF EVALUATING ITS CHANGES UNDER THE INFLUENCE OF TERRITORIAL REDISTRIBUTION OF WATER RESOURCES

Leningrad PROBLEMY ARKTIKI I ANTARKTIKI in Russian No 55, 1980 (signed to press 27 Aug 80) pp 20-43

[Article by V. V. Ivanov]

[Excerpts] In the complex of investigations for the scientific validation of the volumes and sequence of work on the territorial redistribution of water resources of Siberian rivers a considerable place should be occupied by a study of the lower reaches and mouths of rivers in the arctic zone, especially the mouth region of the Ob' [20, 24].

The mouth region of the Ob' River is a complex natural environment situated in the area where the Ob', Nadym, Pur and Taz enter the Kara Sea, within which specific mouth processes occur, these being caused by the interaction and mixing of river and sea waters and delta formation processes [11]. It includes the mouth reaches of the Ob', Nadym, Pur, Taz and an extensive mouth embayment -- Ob' and Taz Bays (Fig. 1).

The degree of hydrological study of the lower reaches and mouths of the rivers in Western Siberia, especially the mouth region of the Ob', is inadequate. At the present time there are only 17 hydrological posts in operation in the mouth reaches of the Ob', Nadym, Pur and Taz, in Ob' and Taz Bays, including the lowest-lying stations on these rivers. The duration of observations at these posts is too inadequate and nonuniform for obtaining reliable probabilistic characteristics of the regime elements and the makeup and number of observation times for a number of stations do not correspond to the programs for the mouth posts. As a rule, observations at shore posts in Ob' and Taz Bays are not representative for open water bodies. Most of the expeditionary investigations of past years, due to their strictly departmental orientation, to a considerable degree are outdated or are no longer pertinent at all [13, 15, 20].

However, on the basis of a generalization of the observational data from the network of stations and individual expeditions available at the Arctic and Antarctic Scientific Research Institute, as well as the results of investigations made earlier [2, 3, 5, 9-15, 18-23, 26 and others] it nevertheless seems possible, with different degrees of detail, to discuss the characteristics of the hydrological regime of this region.

The present-day hydrological regime of the mouth region of the Ob' is formed under the influence of a whole series of factors. The most important of the factors are river runoff with its physicochemical characteristics, the dynamics and thermohaline structure of waters of the sea, and meteorological conditions. A considerable role in formation of the hydrological regime is also played by the relief of the bedrock and alluvial deposits, characteristics of the hydrographic network of deltas, soil-vegetation cover and presence of perennially frozen ground.

In addition, the hydrological regime of the mouth region of the Ob' is being more and more influenced by anthropogenic factors, especially hydroengineering work in the delta associated with a radical improvement in navigation conditions.

The interaction and intercausality of all the external and local factors form the present-day hydrological regime of the river, the long-term, seasonal and brief variability of its individual elements.

However, it must be emphasized that the most important independent factor forming the hydrological regime of the mouth region is river runoff (runoff of water, heat, sediments and dissolved matter). Its absolute value, long-term and seasonal variability to a great extent determine the spatial-temporal characteristics of most of the elements of the hydrological regime in the mouth region of the Ob'. Clear seasonal runoff changes cause large changes in all hydrological elements in mouth areas. Long-term variations of runoff are reflected, in particular, in the nature of development of the hydrographic network of the mouth reaches of rivers and accelerate or slow down the channel process in the arms of deltas and in bars.

An analysis of available data on the hydrological regime of this region shows that with respect to most elements of the hydrological regime their degree of study is inadequate for obtaining comparative evaluations of the regime under present-day conditions and under conditions of a territorial redistribution of water resources of Siberian rivers.

The basis for the feasibility and necessity of diverting part of the flow of northern and Siberian rivers into Central Asia, Kazakhstan and into the Volga basin is a water consumption hypothesis according to which in the immediate future the technological procedures for the use of water will not experience significant changes. The specific indices of expenditures of fresh water per unit of production will be reduced at lower rates than the increase in the volumes of output of production in water-consuming branches. In order to cover the water deficit in the southern regions of the country, even with the complete use of water resources, according to different estimates, it will be necessary to draw upon some of the flow of northern and Siberian rivers. For the European USSR the volume of removal from northern rivers in the immediate future should be 25-35 km^3 of water annually with a subsequent increase to 50-70 km^3, whereas for the Asiatic USSR the volume of removal from Siberian rivers should be 25-60 km^3 of water per year with a subsequent increase to 90-100 km^3 [6, 8, 25].

At the present time in different stages of planning work there are a considerable number of variants of the territorial redistribution of water resources in which plans call for the removal of water from large rivers of the basins of the White, Pechora and Kara Seas [4,6-8,17,25].

These variants with respect to the preservation of natural resources and rational economic activity in the lower reaches and mouths of the rivers of Western Siberia can be divided into two fundamentally different groups.

The first group of variants provides for the separate supply of water to the southern regions of the European and Asiatic USSR. The water shortage in the southern regions of the European USSR is compensated for the most part at the expense of the flow of rivers in the basins of the White Sea, Barents (Pechora) Sea and Baltic Sea, as well as the water resources of lakes in the northwestern European USSR. The water shortage in the southern regions of Kazakhstan and Central Asia should be satisfied by the diversion of part of the flow of the Siberian Rivers Ob', Irtysh and Yenisey into these regions.

The second group of variants provides for the joint solution of water supply to the European and Asiatic parts of the USSR. The basis for these variants is the idea of withdrawal of water from the lower reaches of the Ob' and its diversion across the Urals into the basin of the Pechora River and then into the Volga, to which the flow of other northern rivers will also be diverted. In this case the water supply of the Asiatic USSR will be accomplished from the Volga. The difference in the variants of this group, in particular, is in the choice of the site and type of water intake in the lower reaches of the Ob', and also the routes for the diversion of Ob' waters across the Urals into the Pechora and the Volga basin.

The totality of all the technical solutions for the territorial redistribution of water resources will make it possible to create a unified water management system. In this case the proposal is to use the mouths of rivers as regulating basins, which will make it possible to maneuver water resources over large areas, taking into account the asynchronicity (asynphasicity) of streamflow and water consumption [6].

It should be noted that the idea of use of Ob' Bay and Yenisey Gulf as reservoirs, expressed earlier by V. S. Antonov [1,2] and being developed at the present time in connection with the projects for diverting part of the flow of Siberian rivers, despite all the attractiveness of its implementation, should be subjected to a critical evaluation from the point of view of preservation of the environment and economic activity in the Arctic.

At the present stage the most probable and primary variants for diverting part of the Ob' flow into the southern regions of Kazakhstan and Central Asia must be considered the projects of the Soyuzgiprovodkhoz (State All-Union Institute of Water Management), which can be assigned to the first group of variants. This involves the withdrawal of water from the Ob' at Belogor'ye in a volume of 25 km^3 of water annually using the pumping stations on the Irtysh (the anti-river) to the Tobol'skoye Reservoir and then by canal to the south through the Turgayskiy Pass (variant 1) or the same variant, but without construction of the Tobol'skoye Reservoir (variant 1a). In the second stage the volumes of streamflow diverted from the Ob' are to be increased to 60 km^3 of water annually.

As a supplement to these basic variants, at the present time consideration is being given to the possibility of maintaining the level of the Ob' by diverting part of the flow of the Yenisey from the planned Osinovskoye Reservoir [8].

In ending this examination of the possible planning variants for the territorial redistribution of water resources of Siberian rivers, it should be noted that any variants to one degree or another will exert an influence on the change in the hydrological regime of the lower reaches and mouth region of the Ob', and some of them also on changes in the regime of the lower reaches and mouth region of the Yenisey. The degree of the effect of territorial redistribution of water resources on nature and the economic activity of the lower reaches and mouth region of these rivers will be dependent not only on the volume of streamflow removed annually, but also on the nature of its withdrawal in the course of the year, site and type of water intake structures.

In a general case, regardless of the specific plan for the withdrawal of water from the Ob' and Yenisey, the problem of evaluating changes in the hydrological regime of the lower reaches and mouths of rivers in Western Siberia under the influence of the territorial redistribution of water resources should include a whole series of independent and at the same time, interrelated aspects:
--determination of the quantitative patterns of formation of the hydrological regime of the lower reaches and mouth regions of rivers and the role of river flow in its formation under present-day conditions;
--determination of methods for modeling and computing the hydrological regime and processes in the lower reaches and mouth regions of rivers suitable for obtaining evaluations of the change in regime and processes beyond the limits of the natural ranges, applicable to specific geographical features;
--collection of data on the proposed characteristics of flow, water temperature and quality in the lower pool of water intake structures, taking into account nonreturn water consumption for economic needs for a long period in advance for different planning variants;
--evaluation (prediction) of change in the characteristics of streamflow and the hydrological regime in the lower reaches of rivers, in the reaches from the lower pools of water intake structures to the lowest-lying gauging stations on the rivers for the considered planning variants;
--evaluation of the change in the characteristics of the hydrological regime of the mouth regions of rivers under the influence of withdrawals and regulation of streamflow for the considered planning variants;
--evaluation of the consequences of changes in regime and processes in the environment and the effectiveness of the principal branches of the national economy for the considered variants;
--formulation of criteria for the maximum admissible changes in regime elements and processes in the mouth regions of rivers with respect to preservation of the environment and prospects for the development of the national economy, and as a result of this, determination of the maximum admissible withdrawals of the streamflow of Siberian rivers;
--development of measures for preventing unfavorable consequences of the territorial redistribution of water resources with respect to preservation of the environment and the prospects for the development of individual branches of the national economy in the mouth regions of rivers.

In addition, with greater withdrawals of streamflow the need arises for evaluating the possible change in the ice-hydrological regime of the Kara Sea and the meteorological conditions in the Far North as external factors in formation of the hydrological regime of the mouth regions of rivers.

Each of the enumerated aspects of the problem in turn includes a whole series of problems, the degree of whose development at the present time applicable to different variants of diversion of streamflow and the geographical features affected by them in the zone of streamflow withdrawal is not identical.

In order to validate the work in the first stage of territorial redistribution of water resources of Siberia, a factor of decisive importance is a knowledge of the quantitative regularities in the formation of the hydrological regime and processes in the mouth regions of the Ob' and Yenisey Rivers, where it is necessary to expect the maximum changes as a result of withdrawals and intraannual redistribution of streamflow. However, as indicated by a preliminary study of the problem, carried out recently at the Arctic and Antarctic Scientific Research Institute, the general degree of study of the hydrological regime (including the ice and hydrochemical) mouth regions of the Ob' and Yenisey is inadequate for preparation of valid forecasts of the change in these regimes and processes both as a result of partial withdrawal and regulation of streamflow and under the influence of economic activity in these regions.

The following elements of the hydrological regime and processes have been studied very poorly:
-- the water balance of the mouth regions of rivers, especially inflow from territories of the tundra zone below the lowest-lying gaging stations on large rivers which are unstudied with respect to runoff;
-- the water regime of the mouth reaches of rivers, particularly the distribution of discharges and water levels in the deltas of the Ob' and Yenisey Rivers with their many distributaries;
-- the dynamics of waters of mouth inlets (bays and gulfs), including the dynamics of the hydrological front and the range of propagation of sea waters into rivers with different runoff conditions and sea conditions;
-- channel processes in river deltas with the present-day complex of economic activity, especially the evolution of the hydrographic net of the deltas and the direction of development of deltas as a whole, the processes of formation of mouth bars and sand banks, the influence of long-term permafrost on the channel process, the lithodynamics of the shore zone;
-- the heat balance and thermal regime of the mouth regions of rivers in general and for individual regions in different seasons of the year, especially in the transition periods of spring and autumn;
-- processes of cooling of waters, ice formation, setting-in of the ice and its growth during the autumn-winter period, and also the processes of destruction of the ice cover in the mouth regions of rivers, especially in the open water areas of mouth inlets;
-- the hydrochemical regime of the mouth regions of rivers, including changes in total mineralization and concentration of the main components of the ionic composition of waters, the distribution of contaminating substances and their transformation, biological and microbiological characteristics of the waters in the mouth

regions of rivers in different seasons of the year in interrelation to hydrological processes;
-- the meteorological regime of open areas of mouth regions of rivers and the territories adjacent to them.

With respect to most of the enumerated regime elements and processes as a rule there are some data making it possible to form general ideas concerning the nature of the natural phenomenon but not making it possible to compute reliable characteristics of the mean state of its long-term and interseasonal variability. The unsatisfactory degree of study of the mouth regions of the Ob' and Yenisey Rivers is attributable to the inadequate development of the network of hydrometeorological stations and posts, the great amount of work involved in expeditionary investigations of the arctic regions and the poor development of fundamental investigations of the hydrology of the mouths of rivers in the arctic zone.

This is attributable to the fact that by no means for all the elements of the hydrological regime are there computation and modeling methods suitable for reliable solution of the problem of evaluating changes in the regime and processes for individual sectors of the mouth regions of Siberian rivers under the influence of water management measures, not to mention methods for complex evaluations of the change in the hydrological regime, taking into account the long-term effect of withdrawals of flow and secondary relationships among the changes in the regime elements. Existing computation and modeling methods for individual regime elements usually require their adaptation to specific features and also experimental determination of the necessary empirical data, which at the present time in most cases are lacking [13, 20].

Thus, the present status of the hydrological study of the mouth regions of Siberian rivers, and also the development of methods for computation and modeling make it possible to obtain only partial forecasts of the change in individual regime elements for limited water areas as a result of the direct effect of flow withdrawals without taking into account its long-term effect and secondary relationships. Even such limited special forecasts may be correct only for specific planning variants when information is available on the intraannual distribution of the planned water discharges and the modified characteristics of temperature and water quality in the lower pool of a water intake structure.

However, in the overwhelming majority of cases the status of development of the proposed variants for shifting part of the runoff of Siberian rivers does not make it possible to obtain initial data. This is one of the reasons for the lack of development of forecasts of change in the hydrological regime in the lower reaches and mouth regions of Siberian rivers for the specific planning variants for the diversion of part of their flow.

At the present stage in the development of methods for computations and modeling it is possible to count only on approximate evaluations of the change in regime by using special models and carrying out a generalization on the basis of the methodology proposed for evaluations of changes in regime under the influence of withdrawals of flow in relatively small volumes.

It is assumed that all the evaluations and forecasts should be based on unified planning and initial data used as initial and boundary conditions. Depending on the degree of planning work on change in the river runoff and its physicochemical characteristics in the lower pool of water intake structures it is also necessary to refine the natural evaluations of change in the hydrological regime in the zone of streamflow withdrawal.

Despite the theoretical and technical difficulties in creating the enumerated mathematical models and computation methods for the mouth regions of rivers we note that any efforts in this direction will be without results without obtaining sufficiently detailed and insofar as possible synchronously collected information for the poorly studied elements of the hydrological and meteorological regime for specific features. In particular, such information must first be collected for the mouth regions of the Ob' and Yenisey Rivers. This information should include the following data:

a) on the dynamics of the channel network of deltas, including the hydraulic-morphometric characteristics;

b) on the elements of the water and heat balances for the unstudied territories of the tundra zone of the mouth regions of rivers;

c) on the water regime and dynamics of waters of mouth regions in general and for individual regions (the distribution of discharges and levels in the distributaries of deltas, levels and currents in mouth inlets with different states of the river and sea);

d) on the thermal regime, especially in transitional periods -- spring and autumn (the distribution of temperature over the water area and in depth, water temperature in the marginal zones of ice and coastal regions);

e) on the ice regime (times and nature of onset of different phases and the limits of ice distribution over the water area, increase in the thickness of the ice and depth of the snow on the ice, including changes in snow density);

f) on salinity, the chemical composition and contamination of waters in the mouth region, especially on the dynamics of the interaction of sea and river waters in the zone of the hydrological front;

g) on the meteorological regime over the water and ice surface of open water areas in mouth inlets.

Since the maximum admissible withdrawals of flow for individual rivers is dependent on the choice of their evaluation test, particular attention must be devoted to validation of these tests from the point of view of the possibility of maintaining the characteristics of the regime of the lower reaches and mouth regions of rivers in the arctic zone within the limits ensuring both ecological and sanitary-hygienic requirements and normal economic activity.

It is also assumed that on the basis of these evaluations of possible changes in the hydrological regime recommendations must be formulated on prevention of the negative effects of the territorial redistribution of water resources. These recommendations must be formulated from two points of view: preservation of the environment and the prospects for developing individual branches of the national economy. First it is necessary to formulate recommendations on preservation in a natural state of those elements of the regime whose variability exerts the most unfavorable effect on the quality of water resources in the mouth regions of rivers and on economic activity of water transportation and fishing.

In addition, it is necessary to formulate recommendations on improvement in the hydrometeorological support of the national economy in the lower reaches and mouth regions of the rivers of Western Siberia under modified natural conditions. The necessity for carrying out investigations in the latter direction is dictated by the fact that the withdrawal and regulation of the flow of Siberian rivers led to a loss in the information content of long-term series of observations in the network of hydrometeorological stations and posts in the streamflow withdrawal zone, which in most cases will reduce the effectiveness or make unsuitable the methods for ice and hydrological forecasts used for the present in operational practice. In turn, this will result in a deterioration of the hydrometeorological support of the national economy and nonproductive expenditures.

It is proposed that an improvement in the hydrometeorological support be achieved by creating an automated system of hydrometeorological observations for monitoring the change in regime and operational hydrometeorological support of the national economy and also by creating new methods for hydrological forecasts suitable for use under modified natural conditions.

As a special direction in the investigations it is necessary to begin work on the evaluation of possible changes in water resources and natural conditions as a whole in the mouth regions of rivers in the arctic zone of Siberia, and especially of the Ob' and Yenisey Rivers under the conditions of construction of regulating "reservoirs" in their mouth inlets.

In order to ensure the enumerated complex of investigations it is necessary in a very short time to create in the mouth regions of Siberia affected by the territorial redistribution of flow specialized river-mouth hydrometeorological observatories with expeditionary bases and also with a network of hydrological posts associated with them, including automatic hydrometeorological stations in the open water areas of the mouth inlets. First of all such hydrometeorological observatories must be created in the mouth regions of the Ob' and Yenisey Rivers. The task of the expeditionary subdivisions of these hydrometeorological observatories must include the carrying out of systematic observations at hydrological posts in the deltas of the rivers and also at secular and reference sections in the mouth inlets (bays and gulfs). These hydrometeorological observatories should become a reference base for specialized thematic expeditions of the Arctic and Antarctic Scientific Research Institute and other organizations. In addition, on the rivers of the tundra zone of Western Siberia it is necessary to create first-order hydrological posts for the observation of runoff and other water balance elements. Such posts must be established, in particular, on the Tadibyayakha, Se-yakha, Antipayuta, Nessoyakha and Yuribey Rivers.

The solution of the problem of evaluating the possible changes in the hydrological regime of the lower reaches and mouths of rivers in the arctic zone of Western Siberia under the influence of the territorial redistribution of water resources at the same time will make it possible to formulate correctly and implement a whole series of measures related to the rational use and preservation of the natural resources in these regions.

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5303
CSO: 1865/124

CHANGE IN ICE CONDITIONS IN THE MOUTH REGION OF THE OB' AFTER DIVERTING PART OF THE WATERS INTO CENTRAL ASIA

Leningrad PROBLEMY ARKTIKI I ANTARKTIKI in Russian No 55, 1980 (signed to press 27 Aug 80) pp 49-53

[Article by Yu. V. Nalimov]

[Excerpts] The planned water management measures in the Ob' basin associated with the regulation and withdrawal of part of the streamflow undoubtedly will cause some changes in the process of ice formation, formation and destruction of the ice cover, both in the mouth reach of the river and in its mouth embayment. This can be reflected in a shortening of the navigation season and can introduce some changes into the activity of other branches of the national economy of the mouth region of the Ob'.

An investigation of the ice thermal regime in the natural state is made on the basis of data from the network of observations, which has an extremely nonuniform distribution along the length of the Ob' and in its mouth region. Most of the points for stationary observations are concentrated at the headwaters of the river. The network is extremely poorly developed in the mouth region of the Ob'. In addition, in the mouth embayment the land stations insure observations only in a narrow coastal zone and provide no information on ice processes in open ocean areas, that is, on the usual navigation routes.

The small number of posts for making stationary observations at the mouth of the Ob' makes it difficult to carry out computations and to prepare recommendations on the possible variations in its ice thermal regime and makes it impossible to take these changes into account after accomplishing regulation and nonreturn withdrawal of part of the flow of the Ob'.

In this connection, during recent years in winter, autumn and spring periods specialists of the AANII (Arctic and Antarctic Scientific Research Institute) have been carrying out investigations of the ice thermal regime by aerial methods (remote aerial thickness-gauging survey, ice reconnaissance, aerial temperature survey). The analysis, systematizing and generalization of data from all surface and aerial observations and the computations made and conclusions drawn on their basis served in turn as a basis for preliminary recommendations on possible changes in the ice thermal regime which will occur in the mouth region of the Ob' after the partial withdrawal of streamflow.

V. S. Antonov has published a number of studies [1,2] in which he examines the change in the hydrological regime of the lower reaches and mouth regions of arctic rivers in connection with the possible withdrawal or redistribution of river flow by seasons without taking into account the specific volumes of withdrawal.

In this study in an evaluation of changes in the characteristics of the ice thermal regime in the mouth region of the Ob' as the criterion we have used the volumes of diversion of Ob' streamflow in the first stage of 25 km^3 [4] or a decrease in the mean monthly water discharges at the lowest-lying gauging station at Salekhard during the summer of 1000 m^3/sec, and in winter--600 m^3 sec, and in the second stage 60 km^3 [4] or a decrease in the mean monthly water discharge at Salekhard in summer of 2280 m^3/sec and in winter--1400 m^3/sec.

A quantitative evaluation of the changes in the times for the appearance of autumn ice phases and ice layers in the mouth reach of the Ob' and in its mouth embayment in connection with the withdrawal of part of the river flow is an extremely complex problem due to the complex dependence of these phenomena on a whole series of hydrometeorological and geomorphological factors. In addition, at the present time there are no computation methods which would make it possible, with a known accuracy, to take into account all the combinations of river flow regime and environmental factors which exert a mutual influence on one another. For this reason an evaluation of the change in the times of onset of autumn and winter ice phenomena was made by an examination of the empirical relationships and statistical combinations between the thermal discharges of water, the sum of negative mean daily air temperatures during the period of cooling of water, growth of ice and the duration of the freezing period, and also the time when the ice reaches a definite thickness.

The results of the investigations indicated an absence of a dependence between the thermal flow of the Ob' at the lowest-lying gauging station at Salekhard in the summer-autumn period and the times of onset of ice formation and solid ice cover both in the mouth reach of the river and in the mouth embayment. The processes of ice formation and solid ice cover are here entirely dependent on the meteorological factors prevailing in the mouth region in a specific period of freezing and setting-in of a solid ice cover (air temperature, wind direction and speed, solid precipitation, etc). An evaluation of the changes in the times of clearing of the mouth region of the Ob' from ice was made on the basis of solution of heat balance equations [5,6].

The withdrawal of Ob' streamflow in the first stage of diversion evidently will not exert an appreciable influence on the ice thermal regime of the mouth reach of this river and its mouth embayment in years with an average water volume and in years with increased (above-average) volumes ($P_Q \geq 50$ percent). However, in years with below-average volume ($P_Q < 50$ percent) some insignificant changes in the ice thermal regime will be observed.

In the second stage of diversion the greatest changes in the ice thermal regime of waters will occur only in the mouth embayment of the river.

Thus, with the withdrawal of 60 km^3 of flow annually from the Ob'-Irtysh basin in years with an average water volume (P_Q = 50 percent) the average duration of the ice cover period in the mouth region will increase at Salekhard by 9 days, in the southern part of Ob' Bay--by 10 days, at Cape Kamennyy--by 3 days, and at Tadibeyakha village--by 1 day.

These investigations of the possible changes of the ice thermal regime of the mouth region of the Ob' with the nonreturn withdrawal of part of its flow are preliminary, since they do not take into account the forecast of change in meteorological elements caused by the withdrawal of streamflow, since meteorological conditions play a definite role in the ice regime of this region.

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EVALUATION OF THE INFLUENCE WHICH WOULD BE EXERTED ON WATER TRANSPORTATION BY REMOVAL OF PART OF THE FLOW OF THE OB' AND IRTYSH WITH DIVERSION INTO THE ARAL SEA BASIN

Leningrad PROBLEMY ARKTIKI I ANTARKTIKI in Russian No 55, 1980 (signed to press 27 Aug 80) pp 123-128

[Article by N. A. Khakhin and S. G. Shatayeva]

[Text] The problem of the redistribution of the water resources of rivers in the basin of the Kara Sea involves an extensive central region of the USSR, including the water routes of the Ob'-Irtysh basin, the basin of the Aral Sea, the Balkhash-Ili basin and the basin of Lake Issyk-Kul'. The total volume of transport of cargo along water routes in the region in 1975 was 49 million tons with a freight turnover of 28 billion ton-kilometers. The Ob'-Irtysh basin accounts for more than 90% of the total volume of cargo along the waterways in the region [1].

The central region in part or in whole takes in several economic regions of the country with different economic specialization and different degrees of development of the transportation network. The development of the productive forces of Western Siberia is based for the most part on the use of local resources. With respect to the magnitude of reserves and effectiveness of exploitation the fuel resources (petroleum, gas, coal) stand out in particular. The leading place in the economy of the Ob'-Irtysh basin within the limits of Tyumenskaya and Tomskaya Oblasts will be occupied by the petroleum and gas (production and refining) and forest industries.

At the present time the entire production of petroleum is concentrated in the deposits of the Middle Ob'. In the future the petroleum industry will shift into the northern sectors of Tyumenskaya Oblast, primarily into the Nadym-Purskiy petroleum region, where more than half the total volume of petroleum in the basin will be produced [3]. There will be a considerable increase in the production of gas in the Far North of Tyumenskaya Oblast. The export of wood from the northern sectors of the Ob'-Irtysh basin, according to long-range plans, should almost double in comparison with 1975. The other branches of the national economy will also be further developed. A necessary condition for the timely and effective implementation of the projected plans for capital construction is the prior development of its material and technical base. The production of construction materials will be developed in large built-up industrial centers and also in the immediate neighborhood of the new construction projects.

The development of the national economy of Western Siberia is bringing about a strengthening of inter-rayon and inter-oblast communications and requires an increase in the handling capacity of all types of transportation. The Tobol'sk-Surgut-Nizhnevartovsk Railroad, with its subsequent extension from Surgut to Urengoy, and the major gas and petroleum pipelines to be constructed will solve this problem to a considerable degree. However, for most regions in Western Siberia the key role in the transport of massive cargo of national economic importance during the formation and development of territorial-industrial complexes and the entire infrastructure of the region will be played by water transportation. The total volume of cargo transport by water transportation in the Ob'-Irtysh basin in the coming years will double and then even triple in comparison with today. With the increase in the volume of freight there will be development and improvement of waterways and the material-technical base of water transportation with respect to the fleet, ports and ship repair facilities [5].

The raising of the question of the diversion of flow poses before river transportation a number of extremely complex problems relating to the evaluation of the degree of influence of the intended measures on navigational conditions and also an evaluation of the technical possibilities and economic feasibility of using the channels used in diverting the rivers for navigational purposes.

On the basis of the experience gained in carrying out of studies by the institutes of the River Fleet Ministry RSFSR for substantiating the feasibility of the participation of water transport in integrated water management measures for the territorial redistribution of flow and analysis of the results of the studies made a number of basic requirements have been imposed on navigation as a participant in the water management complex [6].

The first and fundamental requirement on water transportation in the creation of a water management complex on existing river routes used by navigation is the retention of a through transit route. In order to satisfy this requirement it is necessary to provide for the creation of locks in order to bypass dams. The type and size of the locks are determined by the technical-economic indices, depending on the dimensions of the waterway, types of ships and probable volume of freight.

The second requirement on water transportation is the maintenance of guaranteed dimensions of ship channels in the main waterway at the level of the basic variant, taking into account the development of water transportation during the computation period. The creation of a reservoir on a river makes it possible to increase the dimensions of the navigable channel in the upper pool; the dimensions of the channel in the reach below a hydroelectric power or water control structure are dependent on the magnitude of the water discharge. The optimum discharge for water transport must be determined on the basis of the principle of mandatory satisfaction of the plan for transport of cargo with a minimum of expenditures on transportation. In order to ensure navigation conditions below hydraulic structures in a given reach within the range of influence of the diurnal or weekly regulation of the power of hydroelectric power stations, in addition to the mean daily discharge it is also necessary to maintain its distribution within the 24-hour period in order that the guaranteed depths be maintained around-the-clock.

On the basis of the formulated basic principles the Novosibirsk Division of Giprorechtrans [State Institute for River Transport Planning and Research] and the TsNIIEVT [Central Scientific Research Institute of the Economics and Operation of Water Transportation] have prepared specific requirements on water transportation in relation to measures for diversion of part of the flow of Siberian rivers into the Aral Sea basin. In order to ensure the projected volume of transport of cargo by water transportation in the Ob'-Irtysh basin, provision is made for the practical introduction of ships and barges with a draft up to 4 m and a carrying capacity from 5,000 to 16,000 tons.

The implementation of measures for the diversion of part of the streamflow of Siberian rivers into the basin of the Aral Sea and the use of the channels for the diversion of streamflow and drainage distribution canals for navigational purposes in the future will create a deep-water channel linking the coast of the Kara Sea, the Trans-Ural region, Western Siberia, Kazakhstan, the republics of Central Asia and the basin of the Caspian Sea.

All this will enhance the role of water transportation with respect to both intrarayon transport and inter-oblast exchange. Extensive areas will enter within the sphere of water transport. The new water routes will create conditions for the transport of cargo by river transportation for a distance greater than 4,000 km; the total volume of cargo carried by water transportation in the central region will be increased, according to calculations by the authors, to 215-220 million tons with a cargo turnover of 127-180 billion ton-kilometers.

In addition to the positive factors for the development of water transportation, such as the creation of new deep-water channels, the joining of river basins, the attraction of new cargo to water transportation from regions which earlier had no waterways, the implementation of measures for diversion of part of the flow of Siberian rivers into the basin of the Aral Sea will also have a negative effect on the operation of water transportation. Naturally, a decrease in water discharge associated with removal of part of the flow for diversion elsewhere will result in the reaches below the points of removal in a reduction in navigation depths in the channel, that is, all variants of water discharge into the lower reaches less than the former volumes will worsen the conditions for operation of the transport fleet and all the facilities servicing it (ports, industrial enterprises, repair-operational bases of the fleet).

In order to select the optimum variant we examined more than 10 variants of schemes of the route for the diversion of flow from the Irtysh and Ob' to Central Asia. Two of these were deemed acceptable for water transport: 1) with a water intake from the Tobl'skoye Reservoir on the Irtysh with subsequent withdrawal of water from the Ob' in the second stage of construction from the Belogor'ye intake by the Anti-Irtysh; 2) with the same water intake on the Irtysh at Tobol'sk, with the feeding of part of the flow of the Ob' in the second stage of construction via a canal from the Novosibirskoye Reservoir to Pavlodar on the Irtysh.

In each scheme we examined several variants of discharge into the lower pools of the Tobol'skoye, Belogor'yevskoye and Novosibirskoye Reservoirs.

With an ordinary state of the river in the considered long-range period, according to the studies of the Novosibirsk Division of Giprorechtrans, the mean navigational depth in the reach of the Irtysh from Tobol'sk to the mouth and on the Ob' from Sosnino to the mouth was assumed to be 380 cm and in the reach from the Novosibirskiy Hydroelectric Complex to Sosnino -- 310 cm, with guaranteed depths in these same reaches during this same computation period of 330 and 280 cm respectively.

As indicated by the computations, the removal of water from the donor river in all the variants of water discharge into the lower pool will worsen the conditions for navigation in the lower-lying reaches in comparison with the basic variant. At the same time, the receipt of an additional volume of flow into the receiving river as a result of the diversion of part of the flow will worsen the navigation conditions in comparison with the basic variant. A reduced discharge in one river and an increased discharge in the other will change the existing hydrological and morphological characteristics. It is difficult to predict the new patterns. In the first approximation it is possible to adopt the prevailing patterns and introduce corrections. Under the new conditions the depths are determined by extrapolation of the curves of the dependence of water level on water discharge and the dependence of depth on level during recent years. The dependence of depth on level is extrapolated, taking into account the guaranteed depths established for the computation periods.

With the removal of flow at the mentioned points in the reaches below the intakes and hydroelectric power complexes the mean navigational depths can drop by more than 2 m relative to the existing levels (Table 1).

Table 1

Approximate Mean Navigational Depths in Year With Average Water Flow and With Constant Volumes of Dredging Work

Water intake, route sector	Indices	Basic variant	Planning variants			
			1	2	3	4
Tobol'sk intake	Discharge volume, m^3/sec	2200	1300	900	700	-----
Tobol'sk -- on Irtysh	Mean navigational depth, cm	380	310	285	250	-----
Novosibirsk intake	Discharge volume, m^3/sec	1800	1300	900	500	-----
Novosibirskaya Hydroelectric Station -- Tom River	Mean navigational depth, cm	310	285	235	170	-----
Belogor'ye intake	Discharge volume, m^3/sec	9000	8000	5500	4000	3000
Belogor'ye - B. Yary Island	Mean navigational depth, cm	380	345	260	210	175

Under the projected conditions the transport fleet to be put into operation during the considered future period will not be put into full use due to restrictions on draft. In some cases the need will arise for replacing ships of large tonnage and with a deep draft by smaller ships. Under these conditions the expenditures on the transport of cargo will without question increase, thereby inflicting losses on

water transportation, and accordingly on the national economy.

Table 2

Economic Indices of Operation of Ships in the Transport Fleet With Different Draft

Draft, cm	Cost of transport, kopecks/10 ton-km	Specific capital investment, kopecks/ 10 ton-km	Specific reduced expenditures, kopecks/10 ton-km
350	0.8	5.8	1.5
250	1.65	10.1	2.86
160	2.1	18.5	3.75

According to calculations by the authors, the total losses which can be inflicted on water transport by a decrease in depths due to the removal of flow in an examination of the joint operation of hydroelectric complexes-water intakes is reckoned from 14 to 225 million rubles of capital investments and from 2 to 34 million rubles of operational expenses, in dependence on the combination of the volumes of discharges. The specific economic indices of operation of the river fleet with stipulated variants of discharges have considerable variations in dependence on navigational depth and draft of the ships employed (Table 2).

The switching of cargo transport to ships of a lesser draft, and accordingly, a lesser cargo capacity, will cause an increase in expenditures on freight handling. For example, a change in the draft of ships by 1.9 m will increase the cost of freight handling by a factor of almost 2.5. The total expenditures on cargo delivery to the consumer will increase in proportion to the increase in freight handling.

In this case by the "loss to water transport" is meant the additional expenditures necessary in increasing the size of the transport fleet for the mandatory handling of the cargo volume calculated for the considered future period. In addition, due to a change in the ice regime of the lower reaches of the Ob' there will be an increase in losses to water transport due to a shortening of the navigation season.

The duration of the navigation season in sectors of the Gulf of Ob', Pur, Taz and Nadym under ordinary conditions is approximately 100 days. In the event that the navigation season is shortened there will be a need for an additional transport fleet for ensuring the conveyance of mass cargo to remote regions of the Arctic coast, that is, transport expenditures will increase directly proportional to the shortening of the navigation season.

The losses to water transportation with removal of part of the flow for diversion elsewhere were determined applying the methodological premises:

-- a variant of the present state of the river was considered with guaranteed dimensions of ship channels, used in the general scheme for basin development in the considered future period;

-- the navigational depths corresponding to stipulated variants of discharge into the lower pools at hydroelectric power installations were determined;
-- computations of transportation expenditures on the present-day variant and for each of the variants of navigational depths were carried out in accordance with the recommendations of the TsNIIEVT:
-- computations of expenditures were made for the entire route followed by the cargo from the point of origin to the destination point, taking into account expenditures on all elements of the transportation process;
-- as the computed type of fleet we used the most promising types of ships and barges recommended by the general scheme for basin development for the considered future period;
-- computations of transportation expenditures were made assuming mandatory fulfillment of the cargo transport plan, that is, the volume of cargo transport is identical for all variants of the computations.

In addition to a deterioration of navigation conditions and a decrease in water level there will be a deterioration of the conditions for operation of water transportation shore installations. They may have to undergo radical reconstruction or even transfer to another place. The additional expenditures required for restoration of the conditions for normal functioning of port and dock structures and mechanisms, bases for the servicing and mooring of the fleet, ship repair and shipbuilding facilities and navigation conditions also can be included in the losses to water transportation. According to calculations by the authors, the capital investments on the reconstruction of shore facilities, whose need is dictated by the change in the flow regime for the Ob' and Irtysh, is determined, according to the estimates by the authors, to be 28-70 million rubles, depending on the volumes of the discharges into the lower pools at hydroelectric power complexes and their combinations.

As measures for the prevention of losses to water transport with removal of part of the flow it is possible to use a number of engineering measures: construction of locks on river reaches having a flow highly reduced in comparison with the present volume, implementation of dredging work and the construction of river improvement structures.

Accordingly, in order to compensate the removal of flow in the Irtysh below the Tobol'skiy hydroelectric power complex and the restoration of navigational conditions at the level of the present variant with a volume of discharge into the lower pool of less than 900 m^3/sec it is necessary to construct three hydrocomplexes for transportation purposes. The sites of these complexes will be matched with the sites of pumping stations for the feeding of Ob' water along the Anti-Irtysh system in the second stage of the work. The construction of hydraulic complexes in the implementation of measures in the first stage of work on the diversion of flow willafford a possibility of avoiding a sharp deterioration of navigational conditions on the Irtysh and thereby exclude annual losses to the national economy, according to calculations by the authors, amounting to between 6.5 and 65 million rubles due to an increase in expenditures on the delivery of cargo by water transportation. Thus, the losses to the national economy due to inadequate attention to the interests of water transportation only in the course of the decade between the implementation of measures in the first and second stages of the diversion

of the flow of Siberian rivers into the basin of the Aral Sea can be about 650 million rubles of reduced expenditures, which is commensurable with the cost of construction of the compensating hydraulic complexes.

In the case of implementation of such a regime for the regulation of streamflow of which navigation in the reaches below the water intake sites ceases completely, as an alternative it is necessary to consider an alternative variant for the delivery of freight by land forms of transportation. According to the general scheme for the development of the Ob'-Irtysh basin, in the plans for the considered future period no provision is made for the construction of a railroad in the Far North region of Tyumenskaya Oblast. Accordingly, the handling of freight must be assigned to truck transportation. According to report data, the cost of handling freight in this region by truck transport is 106 kopecks/10 ton-km, or 50 times greater than the cost of water transport [2]. In this case the losses to the national economy will increase relative to the above-mentioned values.

The increase in the cost of delivery of freight and the loss to the national economy have not been fully calculated. Unfortunately, there is no method for ascertaining the negative influence from total cessation of navigation on the socio-economic development of coastal regions.

All the major water management measures carried out on river routes must be solved from an integrated approach, taking into account all the branches of the national economy interested in water, as provided for in [4]. In order to meet this requirement, among the planning studies in all stages an evaluation of the influence of withdrawal of flow on the development of water transport must be included as an mandatory part of the technical-economic evaluation of the positive and negative influences of planning measures on navigation conditions along river routes and the routes along which the flow is to be diverted.

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