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GEOGRAPHIC INTELLIGENCE REPORT

HYDROLOGICAL DATA ON SELECTED SOVIET RIVERS

CIA/RR GR-86

January 1956

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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HYDROLOGICAL DATA ON SELECTED SOVIET RIVERS

I. Introduction

This study provides hydrological information for rivers of the Ob' and Upper Volga Basins. Detailed data on the discharge of the selected rivers and the chemical composition of their waters are presented in Tables 2, 3, 5, and 6. River discharge values, stated in monthly and yearly averages, are given for locations at intervals not exceeding 200 kilometers in length. The chemical composition of the water is given in amounts of various ions and total hardness. In the accompanying text, these data are briefly analyzed and compared.

The rivers selected are located in two regions, Western Siberia and Central European USSR. For Western Siberia, data are given for the headwater section of the Ob' River and for the Tobol River along with its west-bank tributaries. For Central European USSR, information covers the Oka River and several of its tributaries.

II. Sources and Evaluation of Data

Much of the information in this study was obtained from Russian publications. Other information came from domestic sources, such as publications of the U. S. Geological Survey of the Department of the Interior.

The most up-to-date data were given in a Russian publication, The River Regimes of the Southern Regions of Western Siberia, Northern and Central Kazakhstan, by P. S. Kuzin, Leningrad, 1953. The publication gives numerous long-term records for the discharge and chemical composition of waters of rivers in Western Siberia. Included are many older hydrological records, as well as recent data based upon observations and samplings during the period from 1940 to 1950. The information on the chemical composition of river waters is particularly significant because it represents samplings taken at various times during the year, as well as at various stages of river flow.

Average discharge values were obtained for 31 selected stations along the rivers of Western Siberia, some with records up to 56 years in length. In most cases the data were adequate for this study.

Data on the discharge and chemical composition of rivers in the upper Volga system were obtained from older publications, principally the Handbook on the Water Resources of the USSR, Vol. III, "Basin of Upper Volga

and Oka," 1935. This publication includes data on discharge rates at selected stations along rivers of the Oka River basin. For the most part the values given are adequate for the Oka, Moskva, and Klyaz'ma Rivers. Where data were incomplete or lacking, interpolations were made. Data on the chemical composition of the water in this area, however, are scant.

III. Hydrological Data

The rate of discharge is given in cubic meters per second for selected points along the courses of the rivers. These discharge rates are given in average monthly and yearly values. If monthly discharge rates were not available for at least one point in every 200-kilometer stretch of river, interpolations were made on the basis of average yearly values. The discharge regime for the interpolated point was calculated by determining the monthly percentage of flow for other stations along the river's course. For some stations, approximate discharge values were based upon values for nearby rivers with similar regimes. The interpolated and approximate values may vary somewhat from the true rates of discharge because no two rivers have identical discharge characteristics. In cases where records were not for the same periods of observation, average rates of discharge may vary considerably.

The months of high water and low water are indicated in the tables. The greatest monthly volumes of water usually coincide with the period of spring thaw and the breaking-up of the ice on the rivers. The low monthly discharge occurs during the winter, when freezing restricts the amount of run-off. In their upper courses the rivers have little or no flow during the winter months when the rivers are frozen solid.

The chemical composition of the river water is based upon quantitative analysis. Most of the samplings on record include the amount of significant ions and dry residue present and the hardness of the water.

In this study the hardness of the water in rivers of the Ob' system is indicated as total hardness in parts per million, based on equivalent values of calcium and magnesium. For the Oka River system the data on total hardness were converted to parts-per-million values from degrees of hardness.

In order to compare the total hardness for different rivers and different localities, a relative total hardness scale has been used. This scale is

based upon the subdivisions of A. O. Alekin* as given below:

Relative Hardness	Parts per Million
Very soft	0 - 75
Soft	75 - 150
Moderately hard	150 - 300
Hard	300 - 450
Very hard	Over 450

A. The Ob' River System

The Ob' River and its tributaries form one of the major river systems of Siberia. The system drains a large area of Western Siberia from the Altay Mountains on the south to the Arctic Ocean on the north and from the eastern flank of the Urals eastward toward the edge of the Siberian Lowland.

The Ob' River proper is formed by the confluence of the Katun' and Biya Rivers at latitude 52°30'N and longitude 85°E near the city of Biysk. The river flows roughly northwest and enters Ob' Bay at approximately 66°45'N - 69°00'E. The section of the river examined extends from the junction of the Katun' and Biya Rivers to the point where the Tom' River joins the Ob'.

The Tobol River and its tributaries drain the eastern slope of the Ural Mountains. The Tobol itself empties into the Irtysh River at 58°10'N - 68°10'E. This report gives data for the Tobol and two of its tributaries-- (1) the Iset' and its tributary the Techa, and (2) the Tura River and its tributaries the Neyva and the Nitsa Rivers.

Map 1, showing the Ob' River system, gives the location of 31 stations, which are keyed by number to Table 1. The table gives the name of each station, its location, the distance to the mouth of the river, and selected hydrological data.

Table 2 gives the average monthly and yearly discharge values for the same stations and the length of record for each. Discharge values are given in cubic meters per second for the stations along the river's course. Where information was not available for at least one point in every 200-kilometer stretch of river, estimated values are given and the stations for which estimates are made are identified. Table 3 shows the chemical composition of the water for selected rivers in the Ob' River system and gives the number of samples taken at each station. The chemical composition is stated

* As presented in: Klimentov, P.P., Gidrogeologiya (Hydrogeology), Gosgeolotekhizdat, Moskva, 1955, p. 100.

in parts per million of calcium, magnesium, sodium and potassium, bicarbonate, sulfate, and chloride. Total hardness is also given in parts per million. Chemical composition of the water, listed as ions of elements and the total hardness, is given in average, maximum, and minimum values. For maximum and minimum values, the months in which they occur are given.

1. Ob' River

For the headwater section of the Ob' River, long-term records of river discharge are available for Barnaul, Kamen'-na-Obi, and Novosibirsk and estimated values for Shelabolikha and Kozhevnikovo.

The average annual discharge increases from 1440 m^3/sec. at Barnaul to 1810 m^3/sec. at Kozhevnikovo above the junction with the Tom' River tributary. At Barnaul, low water occurs in March and high water in June. From Kamen'-na-Obi to Kozhevnikovo at the end of the headwater section of the river, March continues to be the month of low water but May is the month of high water.

The months of high and low average discharges correspond with the dates of the breaking up of the ice. As indicated on Table 2, the month of lowest discharge along the Ob' River is March, just before the beginning of the spring thaw. On the average, the Ob' River is ice-free at Barnaul by 10 April and at Novosibirsk by 30 April. The peak seasonal discharge occurs during the period of spring thaw and ice break-up.

The chemical composition of the water is given for 2 stations on the Ob' River. At Barnaul, the averages were based on 6 samplings, which were taken during the spring and fall months. When these samplings were taken, the average river discharge was 2.2 times the yearly average. Under these conditions, the concentration of constituent elements may be slightly lower than average. At Novosibirsk, on the other hand, 56 samplings were taken during all seasons of the year, and these readings were averaged. The average river discharge at the time of these samplings was 1.7 times the yearly average.

The total hardness of the water varies from very soft at Barnaul to soft at Novosibirsk. The softness of the water is due to the low concentration of calcium and magnesium. At Novosibirsk the average concentration is

37.7 parts per million of calcium and 8 parts per million of magnesium. The maximum concentration of calcium and magnesium occurs during the autumn and early spring, when the river discharge is relatively low, whereas the minimum concentration occurs during the months of high water in late spring and early summer.

2. Tobol River

Discharge values are given for 9 stations along the Tobol River from its headwaters near the southeastern end of the Ural Mountains to the point where it empties into the Irtysh River. The average yearly discharge of the Tobol River increases from 19.1 m^3/sec. at Grishenka near the source to 810 m^3/sec. at Lipovka, 103 kilometers above the river's mouth. At Grishenka, the Tobol River has no flow during January and February, and peak flow occurs in April.

Along the lower course of the Tobol River, the peak flow occurs during May. Here, as on the Ob' River, the month of high discharge follows the breaking-up of the ice.

The chemical composition of the water is given for 3 points along the Tobol River. The samplings at Grishenka were taken during periods when the discharge of the river was 32 times its annual average; the 16 samplings at Kustanay when the discharge was 12 times its yearly average; and the 22 samplings at Kurgan when the discharge was 3.3 times the yearly average.

The sum of the ions in parts per million was 294 at Grishenka, 866 at Kustanay, and 738 at Kurgan. In this area, as along the Ob' River, the maximum concentration of minerals occurs during periods of low water, and the minimum concentration during high water.

The total hardness of the water for the Tobol River is much higher than that of the Ob'. At Kustanay on the Tobol the hardness of water is about 445 parts per million, whereas at Novosibirsk on the Ob' River the hardness is 127 parts per million.

3. Tobol River Tributaries

Along the Iset' River, average annual and monthly discharge values are given for 7 stations. The annual discharge increases from 4.95 m^3/sec. at Sverdlovsk to 80.3 m^3/sec. at Isetskoye, 631 and 117

kilometers above the mouth of the river, respectively. High water occurs in May as far downstream as Bobrovskoye. Along the remaining downstream section of the Iset' River, April is the month of peak discharge. Low water occurs during August at Sverdlovsk at the head of the river, during December along the middle course, and during January and February on the lower course.

On the Techa River, a tributary of the Iset' River, the average yearly discharge increases from 2.12 m^3/sec. at Brodokalmak, 125 kilometers from the mouth, to 12.8 m^3/sec. at Pershinskoye, 26 kilometers above the mouth. April is the month of high water and January the month of low water.

The Neyva River flows into the Nitsa River, which in turn is a tributary of the Tura River. Along the Neyva-Nitsa the annual discharge increases from 8.81 m^3/sec. at Cheremshanka on the Neyva to 44.1 m^3/sec. at Irbit on the Nitsa. High water occurs in April and May and low water during the period from December to March.

The average annual discharge of the Tura River increases from 27.2 m^3/sec. at Verkhotur'ye, 706 kilometers upstream, to 178 m^3/sec. at Tyumen', 175 kilometers above the mouth of the river. On the Tura River, May is the month of high water and February the month of low water.

Dams located on the Tura and Neyva Rivers tend to equalize the flow of the two rivers. The peak spring flow is used to build up the water supply in the reservoir. This water is later released to regulate the operating discharge through the low-water period of winter.

On the Neyva River, a series of dams has been built above the city of Alapayevsk to maintain the flow of the river at an even level along the remainder of its course. The record of discharge for the Neyva River at Alapayevsk, as given in Table 2, is based on older records taken before these dams were built.

The estimated discharge values at Verkhotur'ye on the Tura River were based on the regulating effect of dams on the headwater section of the river. At the Verkhotursk hydroelectric installation the controlled discharge is 14.6 m^3/sec.

The chemical composition of the water of the Tobol River tributaries is indicated by samplings taken at 6 points on the Iset', Techa, Neyva, Nitsa, and Tura Rivers. The data for these stations are presented on Table 3.

The total amount of minerals found in the water of the Tobol River tributaries is much lower than that of the Tobol River proper. At Turinsk on the Tura River, the sum of the ions is 176 parts per million as compared with 738 parts per million at Kurgan on the Tobol River. The total hardness of the water of the tributaries is also much lower. At Volkovo on the Iset' the total hardness is 139 parts per million, as contrasted with 326 parts per million at Kurgan on the Tobol River.

B. The Oka River System

The Oka River system, which has a drainage area of 245,000 square kilometers, is located in the central part of European USSR. In this investigation, the Oka River and its tributaries, the Moksha, the Protva, the Moskva, and the Klyaz'ma Rivers are discussed.

The location of these rivers as well as the stations along their courses are indicated on Map 2. Table 4 lists the stations and their locations, along with the available hydrological data. Table 5 gives the average monthly and yearly discharge values for rivers in the Oka River system. The chemical compositon of the water is shown in Table 6.

1. Oka River

The Oka River has its source at about latitude 52°20'N and longitude 36°10' and from there follows an irregular course northward and then northeastward. At about 56°20'N-44°00'E the river empties into the Volga. The Oka River has a length of 1,480 kilometers and a drainage area of 245,000 square kilometers.

The average annual discharge of the Oka River increases from 20.1 m^3/sec. at Orel to 936 m^3/sec. at Murom. The greatest average discharge occurs in April. The lowest average discharge occurs in January near the source of the river and in February from Kashira downstream to the mouth of the river.

The chemical composition of the water of the Oka River is represented by samplings taken along its course at 3 points: (1) near the mouth of the

Protva River, (2) above the mouth of the Moskva River, and (3) 20 kilometers above the point where the Oka River empties into the Volga. These samplings are given in average, maximum, and minimum values. The dissolved solids are listed as dry residue measured at 110°C.

The chemical analyses of water of the Oka River indicate that the mineral content decreases from the source to the mouth. The average amount of dry residue drops from 295.2 parts per million at Drakino to 259.6 parts per million at Protopopovo. The concentration of calcium and magnesium also decreases downstream from Drakino. The total hardness of water decreases from 263 parts per million at Drakino to 224 parts per million at Novinki.

2. Oka River Tributaries

The discharge records of the Oka River tributaries, which were made prior to 1931, are listed as monthly and yearly values for 6 stations, 4 of which are located on the Moskva River and 2 on the Klya'zma River.

The estimated discharge values of the Moksha River shown on Table 4 are based on known average yearly discharge values for all selected stations and a record of the monthly discharges at Mokraya Polyana for the period from April to November.

Discharge values are given for 4 stations along the Moskva River. The average annual discharge increases from 9.5 m^3/sec. at Mozhaysk to 58.6 m^3/sec. at Bab'egorodsk Dam in the city of Moscow. The discharge is highest in April. Lowest average discharge occurs in January on the headwaters of the river and in February from Zvenigorod downstream.

For the Klyaz'ma River, the major tributary of the Oka River, discharge records are available for only 2 stations--Pavlovskiy Posad, near Gorodok, and Usad, 423 kilometers above the mouth of the Klyaz'ma River. The monthly discharges for the stations of Vladimir and Kovrov were estimated. April is the month of high water and February of low water. This monthly flow pattern is characteristic of the entire Oka River system. The discharge is lowest when the rivers are frozen over and run-off is at a minimum. Maximum discharge, on the other hand, occurs when the ground thaws and the ice breaks up.

The chemical composition of the water of the Oka River tributaries is indicated by samplings taken at 3 stations on the Moskva River, 3 on the Klyaz'ma River, and 1 on the Protva River. Estimates of the chemical composition of the waters of the Oka and Moskva Rivers are also derived by averaging a number of samplings taken at various points along each of the rivers. The Moskva River samples were taken at Rublevo, at Tatorovo, and in Moscow at Moskvoretsiy Bridge where samples were taken for nearly every month of the year during 1926. In the figures for the chemical composition of the water of the Klyaz'ma River, based on 6 samplings taken at 3 points along the river, calcium and magnesium are listed together.

When the chemical composition of the water of the Oka River tributaries is compared with that of the Oka River proper, several generalizations can be made. The concentration of minerals in the water of the tributaries, particularly the sulfate concentration, is much lower than that of the Oka River. The total water hardness of the tributaries is also considerably lower than that of the Oka River proper. Finally, the concentration of mineral constitutents in the tributaries, like that of the main river, decreases from the sources to the mouths.

Table 1

LOCATION OF STATIONS AND INDICATED HYDROLOGICAL DATA FOR OB' RIVER SYSTEM

River	Station No.	Station Name	Coordinates N.Lat.-E.Long.	Distance from Mouth in Km.	Rate of Discharge a/	Chemical Composition
Ob'	1	Barnaul	53°19'-83°19'	3,429	x	x
"	2	Shelabolikha	53°25'-82°40'	3,290	Est.	
"	3	Kamen'-na-Obi	53°47'-81°22'	3,164	x	
"	4	Novosibirsk	55°00'-82°57'	2,955	x	x
"	5	Kozhevnikovo	56°15'-84°00'	2,768	Est.	
Tobol	6	Grishenka	52°23'-61°43'	1,395	x	x
"	7	Kustanay	53°12'-63°38'	1,203	x	x
"	8	Ust'-Uyskoye	54°16'-63°58'	1,003	Est.	
"	9	Zverinogolovskoye	54°28'-64°52'	891	Est.	
"	10	Kurgan	55°26'-65°23'	708	x	x
"	11	Ust'-Suerskoye	56°02'-65°50'	575	Est.	
"	12	Yalutorovsk	56°41'-66°21'	416	x	
"	13	Ievlevo	57°35'-67°09'	137	x	
"	14	Lipovka	57°49'-67°24'	103	x	
Iset'	15	Sverdlovsk	56°50'-60°37'	631	x	
"	16	Bobrovskoye	56°40'-60°58'	593	x	
"	17	Temnovskoye	56°27'-61°33'	529	x	
"	18	Volkovo	56°22'-62°02'	452	x	x
"	19	Dalmatovo	56°15'-62°56'	368	x	
"	20	Mekhonskoye	56°09'-64°34'	205	x	x
"	21	Isetskoye	56°29'-65°23'	117	x	
Techa	22	Brodokalmak	55°35'-62°06'	125	x	
"	23	Pershinskoye	56°06'-62°45'	26	x	x
Neyva	24	Cheremshanka	57°44'-60°44'	139	x	x
"	25	Alapayevsk	57°52'-61°42'	64	x	
Nitsa	26	Irbit	57°40'-63°05'	183	x	x
Tura	27	Verkhotur'ye	58°50'-60°47'	706	Est.	
"	28	Bolotova	58°32'-62°26'	555	Est.	
"	29	Turinsk	58°04'-63°42'	430	x	x
"	30	Ust'-Nitsa	57°57'-64°30'	238	Est.	
"	31	Tyumen'	57°10'-65°32'	179	x	

a. "x" indicates that the information is available; "Est." indicates an estimated rate.

Table 2

AVERAGE MONTHLY AND YEARLY DISCHARGE VALUES FOR OB' RIVER SYSTEM

River	Station No.	Station	Yrs. of Record	Discharge in Cubic Meters per Second												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly
Ob'	1	Barnaul	27	302	271	266*	1,949	3,453	3,598**	2,457	1,691	1,235	1,001	596	366	1,440
"	2	Shelabolikha a/		320	270	230*	1,370	3,810**	3,570	2,300	1,630	1,115	915	530	390	1,365
"	3	Kamen'-na-Obi	42	331	280	237*	1,425	3,966**	3,718	2,602	1,704	1,164	953	554	408	1,420
"	4	Novosibirsk	56	392	334	315*	1,880	5,170**	4,260	3,030	2,020	1,440	1,160	698	483	1,760
"	5	Kozhevnikovo a/		395	337	319*	2,170	5,310**	4,300	3,050	2,030	1,450	1,180	707	487	1,810
Tobol	6	Grishenka	6	0.0*	0.0*	13.4	173**	4.99	1.65	0.97	0.78	0.54	0.56	1.15	0.69	19.1
"	7	Kustanay	15	1.0	0.83*	1.80	192**	33.7	6.81	3.71	3.78	2.78	2.89	2.65	1.53	22.8
"	8	Ust'-Uyskoye a/		1.2	1.0*	2.2	234**	41.0	8.5	4.5	4.5	3.4	3.5	3.2	1.9	27.8
"	9	Zverinogolovskoye a/		3.6	2.9*	4.1	79.2	194**	55.5	14.3	15.0	10.3	9.8	9.0	4.1	33.5
"	10	Kurgan	30	4.3	3.81*	3.85	140	264**	53.6	18.7	15.9	13.6	12.2	10.5	6.7	47.7
"	11	Ust'-Suerskoye a/		4.3	3.9*	3.9*	141	267**	54.0	19.0	16.0	13.7	12.3	10.6	6.8	48.2
"	12	Yalutorovsk	40	23.1	22.1*	23.0	204	494**	211	72.6	61.8	46.3	42.7	32.8	25.4	101
"	13	Ievlevo	24	45.3	44.5*	45.9	180	1,041	1,406**	505	231	165	112	56	48.6	291
"	14	Lipovka	47	151	128	125*	518	2,441	2,560**	1,622	849	618	519	346	222	810
Iset'	15	Sverdlovsk	9	3.45	3.83	4.15	4.91	9.70**	5.77	3.54	3.30*	3.87	4.56	4.81	4.53	4.95
"	16	Bobrovskoye	4	16.5	13.2	13.4	18.4	25.1**	14.0	11.1	8.9	12.2	8.84	5.82	4.51*	12.5
"	17	Temnovskoye	5	3.40	4.06	6.05	15.8**	15.7	10.5	5.93	4.74	4.14	4.31	3.60	3.11*	5.91
"	18	Volkovo	15	5.06	4.69*	5.39	61.7**	32.0	17.2	16.2	15.3	12.8	10.4	7.43	5.52	16.2
"	19	Dalmatovo	8	3.08	2.91*	4.93	68.7**	22.4	19.0	15.0	12.8	10.0	8.48	8.01	4.25	14.8
"	20	Mekhonskoye	13	18.6	17.7*	18.5	293**	193	66.4	48.3	54.7	40.4	39.6	31.1	22.2	79.0
"	21	Isetskoye	10	17.0*	17.5	19.6	274**	207	63.1	51.5	55.6	44.8	48.6	39.8	23.0	80.3
Techa	22	Brodokalmak	1	0.33*	0.94	0.41	5.94**	2.80	2.11	2.75	3.83	2.40	1.51	2.05	0.47	2.12
"	23	Pershinskoye	9	3.15*	3.59	3.79	48.1**	28.8	13.6	11.6	9.56	8.93	10.7	8.22	3.16	12.8
Neyva	24	Cheremshanka	11	2.88	3.53	4.09	29.2**	17.7	9.09	8.07	8.67	7.58	6.80	5.28	2.87*	8.81
"	25	Alapayevsk	6	5.07	4.46	4.04*	32.5**	29.9	16.8	12.1	10.9	10.1	9.05	6.99	5.41	9.85
Nitsa	26	Irbit	56	11.6*	11.6*	10.8	147	154**	55.4	36.4	29.9	25.9	21.2	15.1	12.3	44.1
Tura	27	Verkhotur'ye a/		11.0	10.0*	10.0*	30	90**	50.0	26.0	23.0	20.0	17.0	14.0	12.0	27.2
	28	Volotova a/		15.0	13.0*	13.0*	140	415**	215	130	95.0	90.0	70.0	40.0	20.0	105
"	29	Turinsk	15	16.5	14.4*	14.5	162	476**	248	148	105	102	82.8	42.9	22.0	120
"	30	Ust'-Nitsa a/		26.0	25.0*	27.0	220	665**	410	190	130	105	95.0	65.0	37.0	165
"	31	Tyumen'	55	27.4	27.1*	28.7	232	707**	437	204	138	112	100.0	68.9	39.3	178

a. All except the yearly values are estimated.

*Minimum.
**Maximum.

Table 3

CHEMICAL COMPOSITION OF WATERS OF OB' RIVER SYSTEM

River	Sta. No.	Station	No. of Samples		Chemical Composition in Parts per Million: Calcium Ca	Magnesium Mg	Sodium Potassium Na+K	Bicarbonate HCO_3	Sulfate SO_4	Chloride Cl	Total Hardness
Ob'	1	Barnaul	6	Av.	23.5	7.3	7.4	93	18.7	4.7	88.5
				Max.	38.0--May	10.8--May	15.3--June	128.0--May	33.6--May	13.0--May	140--May
				Min.	17.0--May	5.0--May	1.0--Sept	49.1--May	6.6--Sept	2.1--June	63.0--May
"	4	Novosibirsk	56	Av.	37.7	8.0	9.2	152.1	10.6	4.95	127
				Max.	76.0--Mar	16.2--Nov	37.5--July	323.3--Nov	20.6--Mar	15.3--July	242--Mar
				Min.	24.0--Aug	3.0--May	0.2--Apr	40.8--Sept	3.3--Apr June	0.0--June	70--June Aug
Tobol	6	Grishenka	2	Av.	28.6	12.0	48.9	97.7	30.8	75.7	121
				Max.	30.0--Apr	13.1--Apr	78.0--Apr	120.4--Apr	40.3--Apr	102.6--Apr	129--Apr
				Min.	27.1--Apr	10.9--Apr	19.8--Apr	75.3--Apr	21.3--Apr	48.7--Apr	113--Apr
"	7	Kustanay	16	Av.	114.8	38.6	112.4	211.6	140.9	253.9	445.0
				Max.	214.3--Dec	64.6--Mar	234.5--Mar	273.2--Apr	305.2--May	517.5--Dec	790--Dec
				Min.	22.8--Apr	5.6--Apr	3.0--June	60.2--Apr	33.7--Mar	15.6--Apr	80--Apr
"	10	Kurgan	22	Av.	71.5	36.7	104.8	249.6	143.9	131.0	326
				Max.	121.9--Oct	58.4--Mar	225.0--Aug	402.6--Mar	244.0--Mar	207.3--Mar	530--Mar
				Min.	28.2--Apr	17.0--Apr	16.2--Apr	98.8--Apr	17.6--Oct	36.7--Apr	140--Apr
Iset'	18	Volkovo	11	Av.	37.5	11.1	27.0	160.4	28.5	21.5	139.0
				Max.	63.2--Apr	21.4--Apr	66.5--Apr	232.0--Apr	49.2--Apr	41.0--Apr	246--Apr
				Min.	25.1--Apr	4.0--Apr	7.8--Apr	85.4--Apr	16.3--June	10.0--May	92--May
"	20	Mekhonskoye	4	Av.	44.9	15.0	20.5 Sept	169.3	38.5	25.6	174
				Max.	64.1--Dec	23.6--Sept	32.3--Dec	232.4--Dec	60.4--Dec	35.5--Dec	239--Dec
				Min.	19.9--May	4.4--May	9.2--Sept	72.0--May	25.7--May	9.3--May	68--May
Techa	23	Pershinskoye	5	Av.	41.7	13.2	8.8	155.0	27.8	14.3	159
				Max.	58.6--Sept	21.3--Apr	23.0--Apr	244.1--Apr	37.3--Apr	17.3--Apr	218--Apr
				Min.	19.9--Apr	5.6--Apr	3.8--Apr	67.1--Apr	20.4--Sept	8.9--Apr	73--Apr

Table 3 (Cont.)

CHEMICAL COMPOSITION OF WATERS OF OB' RIVER SYSTEM

River	Sta. No.	Station	No. of Samples		Chemical Composition in Parts per Million: Calcium Ca	Magnesium Mg	Sodium Potassium Na+K	Bicarbonate HCO_3	Sulfate SO_4	Chloride Cl	Total Hardness
Neyva	24	Cheremshanka	3	Av.	29.9	12.4	5.7	87.4	52.3	7.6	126
				Max.	36.5--Sept	15.8--Sept	7.3--Sept	96.6--Sept	61.4--Sept	10.0--Sept	150--Sept
				Min.	19.3--May	10.1--May	4.0--Sept	67.1--May	35.0--May	6.1--Sept	90--May
Nitsa	26	Irbit	6	Av.	29.0	10.0	4.9	104.3	29.3	5.4	114
				Max.	52.2--Mar	19.0--Mar	9.5--Sept	170.8--Sept	82.1--Mar	12.0--Mar	208--Mar
				Min.	13.7--May	3.5--Apr	0.5--May	146.4--Mar	11.0--May	0.9--Apr	52--May
			42	Av.	28.2	8.2	8.4	92.9	27.0	11.2	106
Tura	29	Turinsk	42	Max.	64.3--Feb	18.7--Feb	27.2--Mar	262.3--Feb	86.2--Mar Feb	26.8--Aug	238--Feb
				Min.	7.2--May	2.2--June	0.2--Nov	18.3--May	9.0--June	1.5--June	31--May

Table 4

LOCATION OF STATIONS AND INDICATED HYDROLOGICAL DATA FOR OKA RIVER SYSTEM

River	Sta. No.	Station	Coordinates N. Lat. - E. Long.	Distance from Mouth in Km.	Rate of Discharge	Chemical Composition
Oka	32	Orel	52°58' - 36°04'	1,450	x	
"	33	Lichvin	54°06' - 36°16'	1,256	Est.	
"	34	Kaluga	54°30' - 36°16'	1,171	x	
"	35	Drakino	54°51' - 37°17'	1,050		x
"	36	Kashira	54°50' - 38°10'	986	x	
"	37	Protopopovo	55°03' - 38°46'	919		x
"	38	Shchurovo	55°04' - 38°51'	915	Est.	
"	39	Polovskoye	54°28' - 40°13'	704	Est.	
"	40	Kasimov	54°56' - 41°24'	442	Est.	
"	41	Murom	55°35' - 42°04'	232	x	
"	42	Novinki	56°12' - 43°53'	20		x
Moksha	43	Mokraya Polyana	53°34' - 44°23'	570	Est.	
"	44	Narovchat	53°52' - 43°44'	465	Est.	
"	45	Temnikov	54°38' - 43°11'	200	Est.	
Protva	46	Spas-Zagorsk	55°05' - 38°36'	70	Est.	
Moskva	47	Mozhaysk	55°30' - 36°01'	387	x	x
"	48	Zvenigorod	55°43' - 36°51'	295	x	
"	49	Rublevo	55°46' - 37°21'	241		x
"	50	Pavshino	55°48' - 37°22'	236	x	
"	51	Bab'agorodsk Dam	55°45' - 37°35'	188	x	x
"	52	Moskvoretsiy Bridge	55°44' - 37°38'	176		x
Klyaz'ma	53	Shchelkovo	55°55' - 38°01'	536		x
"	54	Uspenskoye	55°52' - 38°30'	490		x
"	55	Pavlovskiy Posad near Gorodok	55°47' - 38°42'	468	x	x
"	56	Usad	55°52' - 39°08'	423	x	
"	57	Vladimir	56°07' - 40°25'	276	Est.	
"	58	Kovrov	56°23' - 41°18'	165	Est.	

a. "x" indicates that the information is available; "Est." indicates an estimated rate.

Table 5

AVERAGE MONTHLY AND YEARLY DISCHARGE VALUES FOR OKA RIVER SYSTEM

River	Sta. No.	Station	Yrs. of Record	Discharge in Cubic Meters per Second												
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Yearly
Oka	32	Orel	44	5.7*	8.3	40.8	118.2**	17.9	9.3	9.3	6.6	6.3	7.3	8.3	5.9	20.1
"	33	Lichvin a/		45*	50	185	725**	160	70	65	50	45	55	65	60	130
"	34	Kaluga	44	114	117	378	1,717**	429	169	163	124	112*	132	166	159	312
"	36	Kashira	5-46	114	95*	308	2,407**	717	236	220	180	164	191	248	189	391
"	38	Shchurovo a/		125	105*	340	2,650**	790	260	230	195	180	205	260	200	430
"	39	Polovskoye a/		128	112*	211	2,530**	1,035	275	240	200	185	210	265	205	463
"	40	Kasimov a/		235	210*	260	2,700**	2,635	470	360	295	280	290	310	265	700
"	41	Murom	50	312	282*	350	3,603**	3,516	625	481	394	370	389	412	350	936
Moksha	43	Mokraya Polyana a/		0.5*	1.0	5	110**	25	4	3	5	4	4	2	1.0	14
"	44	Narovchat a/		1.0*	2.0	13	275**	60	10	8	11	10	10	5	3	34
"	45	Temnikov a/		4.0	3.0*	20	440**	100	15	14	15	16	16	8	4	55.4
Protva	46	Spas-Zagorsk a/		3.5*	4.0	7.5	100**	25	11	4.5	4.0	5.0	9.5	15	3.5	16.9
Moskva	47	Mozhaysk	13	2.1*	2.3	4.6	62.9**	14.7	6.6	2.8	2.5	3.2	6.0	9.1	2.3	9.5
"	48	Zvenigorod	12	8.5	7.8*	14.2	166.7**	52.4	16.5	11.0	10.1	9.2	17.8	28.6	12.2	28.2
"	50	Pavshino	13	13	11*	19	246**	77	23	16	14	17	29	37	20	43
"	51	Bab'egorodsk Dam	4	13.0	10.7*	23.3	355.8**	75.8	57.8	24.6	30.8	33.4	21.8	41.8	14.5	58.6
Klyaz'ma	55	Pavlovskiy Posad near Gorodok	9	8.0	6.4*	10.7	197.7**	76.1	23.3	18.7	14.5	16.4	24.2	39.2	11.2	37.5
"	56	Usad	5	23.0	21.4*	27.8	166.5**	106.3	27.3	26.5	24.2	34.0	43.8	73.3	32.8	53.7
"	57	Vladimir a/		31	28*	40	225**	145	37	36	32	46	60	100	43	75
"	58	Kovrov a/		65	55*	80	450**	290	75	70	65	90	120	200	75	148 b/

a. All except the yearly values are estimated.
b. Based on run-off values.

*Minimum.
**Maximum.

Table 6

CHEMICAL COMPOSITION OF WATERS OF OKA RIVER SYSTEM

River	Sta. No.	Station	No. of Samples		Chemical Composition in Parts per Million: Dry Residue	Calcium Ca	Magnesium Mg	Iron Fe	Sodium Potassium Na+K	Bicarbonate HCO_3	Sulfate SO_4	Chloride Cl	Nitrate NO_3	Total Hardness	Free CO_2	pH
		Drakino		Av.	295.2	77.1	17.1			139.1	41.9	2.6	1.43	263		
Oka	35	above mouth		Max.	354.8	93.5	19.9			155.8	53.8	3.7	4.6	315		
		of Protva R.		Min.	237.7	65.06	12.13			100.2	26.3	1.5	0.0	214		
				Av.	259.6	69.5	16.3			223.9	29.9	2.6	1.37	240		
"	37	Protopopovo		Max.	347.6	90.4	20.5			307.4	45.2	4.0	5.18	310		
				Min.	105.2	22.7	7.8			89.4	6.4	0.4	0.0	89		
				Av.						184	66.3	8.9	1.14	224		
"	42	Novinki		Max.						261.7	99.6	12.6	11.5	320		
				Min.						54	7.2	3.2	0.0	62		
	Near	Near Drakino		Av.	259.5	69.7	18.2			155.8	6.84	2.6	0.89	251		
Protva	35	on		Max.	309.0	86.0	19.7			168.9	8.76	3.4	4.60	314		
		Protva River		Min.	230.6	57.5	14.7			124.3	4.68	1.3	0.00	223		
		Mozhaysk														
Moskva	47	at		Av.	238	62.2	20.3			261.7	5.9	2.1	0.3	239		
		Marfin Ford														
				Av.	227.2	61.5	14.2		23.0	250.7	5.6	2.3	1.21	213.6	6.4	
"	49	Rublevo		Max.	319.0	92.8	21.0			363.9	8.2	5.0	4.06	307.9	19.6	
				Min.	51.6	11.4	2.2			43.6	0.8	0.7	0.0	37.4		
		Moskboretsiy		Av.	267.9	64.3	14.2			250.7	17.8	8.9		220	14.0	7.68
Protva	52	Bridge	11	Max.	356.7	84.0	18.8			333.2	34.0	14.5		268	26.8	8.3
				Min.	85.2	34.2	6.6			134.8	5.0	3.5		120	0.0	7.28
				Av.	237.6		79.8			209.2	11.6	6.3	1.3	180		7.5
Klyaz'ma	53	Shchelkovo	2	Max.	268		79.8			244.0	11.3	7.5	2.6	216		7.75
				Min.	207.2		78.7			174.5	10.9	5.0	0.0	145		7.26
				Av.			73.3			189.4		8.5	2.3	163		
"	54	Uspenskoye	2	Max.	228		84.0			202.5	12.6	9.0	4.51	173		7.98
				Min.			62.7			176.3		7.9	0.13	150		
		Pavlovskiy		Av.			65.5			169.8		5.4	0.8	144		
"	55	Posad near	2	Max.	206		78.0			178.7	12.6	5.9	1.50	148		7.9
		Gorodok		Min.			53.1			161.0		5.0	0.09	139		
Moskva		Entire Course	34	Av.	242	61.5	13.9			246.3	10.3	4.8		210	10.5	7.73
Oka		Entire Course	14	Av.	306	71.5	16.9	0.19		215.8	43.7	5.4	2.4	245		