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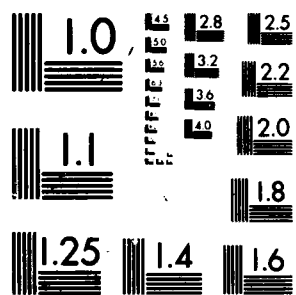
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FOREIGN TECHNOLOGY DIVISION

THE CLIMATE IN THE REGION OF DJERDAP (THE IRON GATE)

by

Katarina Milosavljevic

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THE CLIMATE IN THE REGION OF DJERDAP (THE IRON GATE)

Katarina Milosavljevic,   Belgrade

With three illustrations.

Summary. In order to obtain the climatological characteristics for the region around the Iron Gate (Djerdap), where a barrage is to be built, data was processed from the meteorological stations on the right bank of the Danube in East Serbia in Yugoslavia. The air temperature distribution in this region shows much "harsher conditions" in the eastern part than in the western part. In this region an annual precipitation from 657 to 913 mm was measured T' abundance of sunshine (over 2000 hours per year) is very signi: for the tourism of this region. The mean annual wind speed is 2.6 m/s, but storms are also frequent, from a low of 68 days per year to a high of 156 days per year.

The area of Djerdap (Iron Gate) and the dammed up area of the
Danube which will affect the hydroenergy system of Djerdap lie at
about 44.5° N and 21 to 22.5° E in a region of moderate continental
climate. Much has already been written about the climate in East
Serbia and particularly about the air currents in this part of
Yugoslavia [1, 2, 3, 4]. In connection with the plans for a power
plant meteorological observations and evaluations have been
particularly intensified.   This report represents an excerpt from a
detailed work.

Not only the very well-known Danube crevasse "Iron Gate," but
also the entire area, with its beautiful scenery, is very attractive
in the tourist sense. The Southern Carpathians, the so-called
Transylvanian Alps, extend over the Danube in the area of the Djerdap
gorge (Iron Gate) toward East Serbia and join with the Balkans [5].
The Danube gorge actually begins at Golubac (see map, Ill. 1). The
mountain area is clearly divided and permits air passages from both
the north and northwest in the case of cold air intrusions from the
Pannonian plane and also out of the east from the Walachian plane.

The Iron Gate which is well-known for eddies and rapids, after
completion of the dam, will be turned into calm lake. At high water

the backwater will extend to the mouth of the Nera River. A number of settlements will be flooded. Undoubtedly the large backwater will affect the climate, especially of its shore area.

For the present treatment we used observations of the climatological stations on the right shore of the Danube from Veliko Gradiste, Tekija, Karatas, and Brza Palanka, as well as data on precipitation from 18 measuring points likewise on the right shore between Ram and Prahovo. The period of intensive investigations from January 1966 to June 1969 was used as the primary measuring period. In addition the stations in Beograd above- and in Negotin below the Djerdap storage pond area served for longer observation periods.

Table 1. Monthly mean of the air temperature, the relative humidity, windspeed, cooling value, equivalent air temperature, and the equivalent skin temperature, Belgrade, 1966-1969.

KEY: 1. year; 2. air temperature, °C; 3. relative humidity, °/₀; 4.
wind speed, m/s; 5. climate perception; 6. equivalent air
temperature; 7. equivalent skin temperature; 8. human perception; 9..
cold; 10. cool; 11. very;   12. rather.

Table 2. Monthly mean of the air temperature, the relative humidity,
windspeed, cooling value, equivalent air temperature, and the
equivalent skin temperature, Karatas, 1966-1969.

KEY: see Table 1.

Table 3. Monthly mean of the air temperature, the relative humidity, windspeed, cooling value, equivalent air temperature, and the equivalent skin temperature, Negotin, 1966-1969.

KEY: see Table 1.

Fig. 1. The Danube region with Djerdap (Iron Gate) and the storage
lake (East Serbia, Yugoslavia).

Climate Tables.

Tables 1-3 show the mean values of meteorological and
bioclimatic values over several years. As far as the air temperature
is concerned, Karatas and Negotin have higher values than Belgrade
only in the months of July to September, and then only by an average
of 0.7°C. In all other months the temperatures in the region of
Djerdap are sooner cooler than Belgradeand this is particularly true
for winter.   In February the difference is 2.3° and the humidity in
the more eastern stations is almost 10°/₀ higher than in Belgrade. By
May this excess humidity decreases by about half and the remainder of
the year it is still present but only about 2°/₀. The still
unequalized wind averages in January, March and from June to
September show somewhat higher values in the more eastern locations
than in Belgrade, and in the other months they are somewhat lower.

The annual air temperature fluctuation increases from 23.0°
(Belgrade in the west to 24.9° (Negotin) in the east. The number of
frost days (not published here) also increases from west to east.
Analysis of the extreme temperature values shows that in the summer
the maxima reach equally high values but that in winter the minima,
under the effect of cold air intrusions from the Walachian Plane, are
significantly lower in the eastern parts. Using the monthly mean
temperature and humidity, climate graphs were drawn (not reproduced
here) which coincide in their overall character but which have local
peculiarities and which also show the effect of the water on the

local climate. In winter this effect is slight since the Danube
freezes.

The annual distribution of precipitation in East Serbia,
especially in the Djerdap region, has often been described [1, 2, 3].
According to Vujevic the annual course corresponds to the central
European type with abundant rain in the spring and summer. In the
eastern part of the observed region, however, there is a November
maximum and the summer maximum becomes secondary and shifts to June.
The annual highs of precipitation in the Djerdap region, based upon
the data for 24 stations, are between 657 and 913 mm, whereby the
lower values are for locations near the Danube, and the higher for
mountain locations. The number of days with precipitation, rain, snow
and snow cover can also be found in the original work.

On the other hand Tables 1 to 3 show three different combined
elements which are familiar from bioclimatology and add the
evaluations according to the appropriate perception scales. One first
finds Hill's cooling magnitude H and also the evaluation of the
climate according to Krueger's scale [7], the equivalent air
temperature, and the perception scale according to Schmid [10] and
finally the equivalent temperature of the skin and the attendant
climate evaluation according to Leistner and Robitzsch [11].

Duration of Sunshine and Global Radiation.

On an average over many years in Belgrade there are 2154 hours of sunshine and in Negotin 2096 hours of sunshine per year. The annual maximum was 2437 hours and the annual minimum, 1829 hours. In the time span from 1966 to 1969 the annual average was around 2100 hours (Belgrade 2085, Karatas 2163, Negotin 2069 hours).

In any case the abundance of sunshine is noteworthy and exceeds 2000 hours which is the minimum sum often indicated in climatology for an area to be designated as sunny.

But a study of the annual progress of the duration of sunshine, the number of days without sunshine and the number of days with at least 8 hours of sunshine shows relatively unfavorable conditions from November to February. Then there is a sharp rise from March to July and then a gradual and finally fast drop of the sunshine hours and a rise of the number of sun-free days in the fall.

In April and October every other day there are at least eight hours of sunshine and from May to September there are even more such days and there is seldom a day which remains fully without sunshine.

Global and diffuse celestial radiation data is present from

Belgrade for the time span from 1958 to 1968. For the present
investigation we looked at the correlation of the daily sums of
global radiation and the daily temperature which is a primary
consideration for tourist purposes (here the air temperature at
1400). The collective values were divided into terzils month-by-month
as was done by G. Hentschel [6]; the middle terzil for temperature
was cold, for global radiation - dark; the upper terzil for
temperature was warm, for global radiation - bright. Nine
combinations of the classes are then possible. The values for
Belgrade once again limited to 1966-1969, can be found in Table 4,
the values for Negotin, in Table 5.

Table 4. The relative frequencies according to classes of the values
of air temperature (t) at 1400 and the daily sum of global solar
radiation (g) in °/₀, Belgrade 1966-1969 (VIII).

		Kalt Hell	Normal Hell	Warm Hell	Kalt Normal	Normal Normal	Warm Normal	Kalt Dunkel	Normal Dunkel	Warm Dunkel
Nr.		1	2	3	4	5	6	7	8	9
J		5	7	5	8	17	11	15	22	10
F		7	18	19	4	21	5	13	11	2
M		2	17	11	11	12	11	24	12	.
A		8	20	22	10	12	6	13	7	2
M		1	14	22	22	7	15	6	11	2
J		1	22	29	4	27	4	10	3	.
J		1	30	30	9	15	5	9	1	.
A		2	28	27	4	21	1	16	1	.
S		1	22	27	4	25	5	9	5	2
O		3	15	39	.	19	13	5	4	2
N		2	6	10	7	12	18	27	12	6
D		3	10	6	10	15	2	15	28	11
Jahr		36	209	247	93	203	96	162	117	37
Fr		11	51	55	43	31	32	43	30	4
So		4	80	86	17	63	10	35	5	0
He		6	43	76	11	56	36	41	21	10
Wi		15	35	30	22	53	18	43	61	23
Fr - So		15	131	141	60	94	42	78	35	4
He - Wi		21	78	100	33	109	54	84	82	33

KEY: 1. cold; 2. bright; 3. dark; 4. year; 5. spring;
6. summer; 7. fall; 8. winter.

The numerical values of Tables 4 and 5 are quite similar, the climatic behavior of Belgrade and Negotin also differ little in this respect. In general the class with normal temperatures and normal global radiation is amply represented. Bright days are relatively warm at noon, both summer and winter and dark days are relatively cool at noon. In the summer half of the year, however, even bright days rather frequently only show average noonday temperatures and in the winter half of the year dark days are also frequently moderately tempered. Thus, sunshine does not always mean high daily

temperatures, which is also of interest from the standpoint of tourism.

Table 5. Relative frequencies according to classes of the values of air temperature (t) at 1400 and the daily sums of global solar radiation (g) in °/₀, Negotin, 1966-1969 (VIII).

t \ z	Kalt Hell	Normal Hell	Warm Hell	Kalt Normal	Normal Normal	Warm Normal	Kalt Dunkel	Normal Dunkel	Warm Dunkel
Nr.	1	2	3	4	5	6	7	8	9
J	6	15	10	12	23	6	4	21	3
F	1	10	8	5	26	10	5	33	.
M	6	14	12	7	24	11	15	10	1
A	4	16	18	8	20	13	13	8	.
M	2	34	13	4	31	6	7	3	.
J	.	28	28	10	15	3	9	6	1
J	5	46	14	7	21	2	3	2	.
A	2	27	28	5	15	15	4	4	.
S	5	17	23	2	27	14	9	3	.
O	2	13	20	2	15	27	8	13	.
N	8	3	2	7	8	7	28	35	2
D	2	7	1	9	19	5	15	38	4
Jahr	43	230	177	78	244	119	120	176	13
Fr	12	64	43	19	75	30	35	21	1
So	7	101	70	22	51	20	16	12	1
He	15	33	45	11	50	48	45	51	2
Wi	9	32	19	26	68	21	24	92	4
Fr - So	19	165	113	41	126	50	51	33	2
He - Wi	24	65	64	37	118	69	69	143	11

KEY: 1. cold; 2. bright; 3. dark; 4. year; 5. spring; 6. summer; 7. fall; 8. winter.

Wind Conditions.

The wind speeds shown in Tables 1-3 are not particulary high. On

an average the annual value is 2.6 m/s. There are storms in the
region of the Iron Gate, however, and therefore we want to give
additional data about the wind conditions.

Work [4] reported on the effect of the Transylvanian Alps on the
structure of the east wind. The direction of extension of the isobars
and the horizontal gradients of air pressure were shown there; these
determine the structure of the flow of cold continental air which
blows out of the Ukraine to the west. The investigated characteristic
days had in common very small air pressure gradients above the
Walachian plane and much larger gradients over the mountains of the
Carpathians. Since the cold air mass is very shallow it cannot cross
the high mountains and forms a sea of cold air over Walachia and from
there the cold air for the most part flows through the river valleys
of the Danube, the Timok, the Crna Reka, and others toward the west.
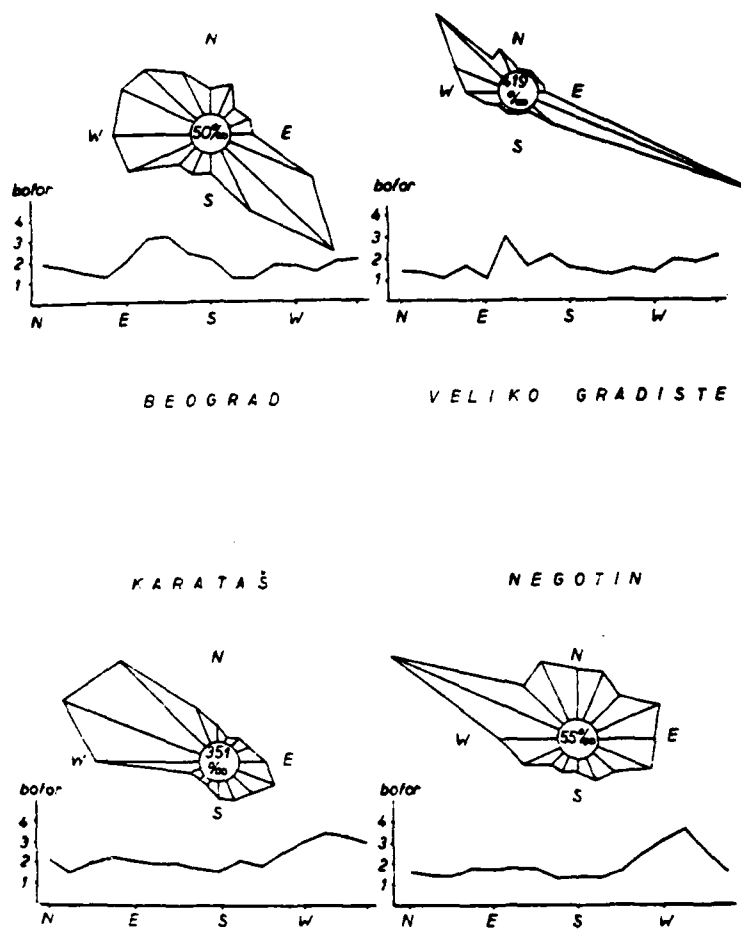Upon leaving these valleys the wind has increased speed and a gusty
character.

Fig. 2. Annual wind roses with the relative frequencies of wind directions and calms in °/₀₀ and the mean value of the wind strength for three locations in the area of the Danube, 1966-1969.
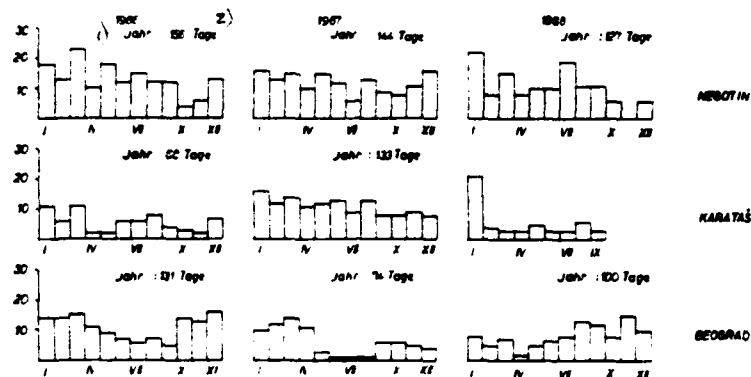
Fig. 3. Number of days with heavy- and storm wind in the Danube area
in East Serbia in Yugoslavia in the years 1966-1968.   KEY: 1. year;
2. days.

   Fig. 2 shows the wind roses for 4 stations of the investigated
region. The general distribution of wind directions shows a
significant opposition between the areas west and east of the Iron
Gate; to the west of Djerdap the winds are predominantly southeast
winds and to the east of Djerdap, northwest winds. The gradient wind
is apparently relieved and in the lower areas there are whirlwinds
with winds from the opposite direction [cf. 7]. Fig. 2 shows the

average wind strengths of the individual directions in Beaufort
degrees. It is apparent that the most frequent wind directions are
also the strongest.

Fig. 3 also shows the number of days with strong winds and storm
winds according to observations from the three years. Freshening up
of the wind to at least Beaufort degree 6 is not a rare occurrence
although the monthly and yearly averages of the wind velocity
themselves are not high. There were days with strong winds in the
years of the special investigations at the three stations depicted in
Fig. 3 ranging from a low of 68 days to a high of 1556 days. A clear
dependence of the strong wind days on the time of year cannot be
recognized from the material. In an average over many years in
Belgrade there are 118 days with occasional or day-long strong winds;
in the year with the least wind there were 74 such days and in the
year with the most wind, 158 such days.

In conclusion one can say that the conditions for tourism are
most favorable from May to September. In October and November, as
well as in March and April they are less favorable because of the
occasional strong winds and the winter months of December through
February are least favorable..

The large storage lake to a certain extent will moderate both

the winter and summer extreme conditions. Certain locations on the shores will be very favorable for viticulture. The main features of the climate of the area, however, will remain similar to the way they were depicted in this report.

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