

THE IRON GATES OF THE DANUBE

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Table of Contents

	<u>Page</u>
Summary	1
A. General Description of the Geology and River Regime.	2
B. The Gorges of the Iron Gates	3
I. The First Gorge.	3
II. The Upper Djerdap (Berdap) Gorge	4
III. The Kazan Gorge (Lower Berdap)	5
IV. The Sipe Gorge (including the Iron Gate)	6

25X1C



Appendix A, Sources and Evaluation of Sources.	10
1. Evaluation of Sources	10
2. Sources	10
a. Documents	10
b. Maps.	11

List of Illustrations

	<u>Following Page</u>
Fig. 1. The Kazan Gorge	1
Fig. 2. Greben.	2
Fig. 3. The Kazan Gorge looking downstream.	3
Fig. 4. The Kazan Gorge looking upstream.	4
Fig. 5. Little Kazan Gorge looking downstream	4
Fig. 6. Looking downstream from Km. 947 (Sip Gorge)	5

~~SECRET~~
SECURITY INFORMATION

Following Page

Fig. 7. The Prigrda. 6
Fig. 8. Downstream entrance of Sip Canal 7

Map

Geology of the Iron Gates Sector of the Danube (CIA 12273)

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THE IRON GATES OF THE DANUBE

Summary

From Golubac, Yugoslavia, eastward to Turmu Severin, Rumania, the Danube River cuts across the Southern Carpathians, flowing for 93 miles through a series of gorges and basins. These gorges and basins, collectively, are commonly known as the Iron Gates. Used in the singular, the term "Iron Gate" applies only to a specific point in the Danube at Sip Gorge, immediately northwest of Turmu Severin (see map CIA 12273).

The Danube varies greatly from place to place in depth, width, and velocity. In the gorges of the Iron Gates the valleys are V-shaped. In many places the sides slope precipitously down to the water's edge and the river fills the entire valley from side to side (see Figure 1).* A road traverses the entire length of the Iron Gates only along the Rumanian bank. The channel is deep and narrow, with occasional pot holes scoured out to depths below sea level, and the current is rapid. In the basins between the gorges the river becomes shallow and spreads out to twice its width in the gorges, and its flow is more sluggish. The channel is divided by sand banks and islands, and occasional small discontinuous plains border the river. The flow of the Danube also varies seasonally, and both high and low water present navigational problems. At the entrance and exit of each basin, rock bars or reefs give rise to rapids and whirlpools at low water and may be completely submerged at high water. These reefs and bars are the major hazards to navigation along

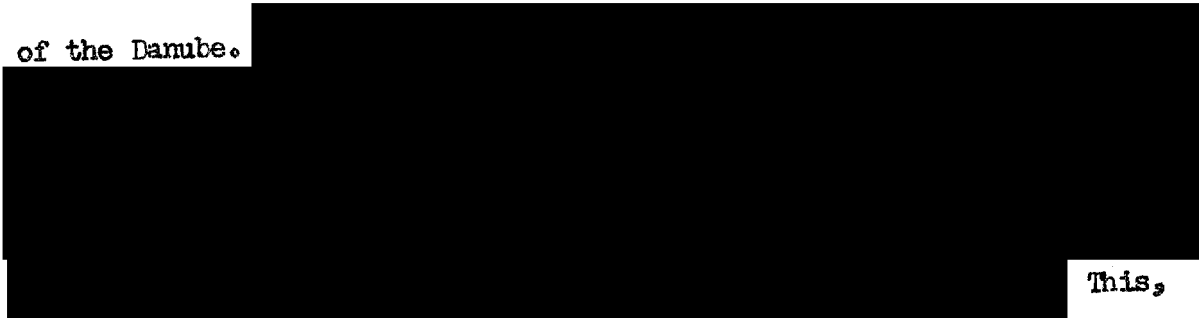
* Figures accompany only the first four copies of this report.

the Danube.

No micro geologic surveys have been made of the Iron Gates section of the Danube.

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This,

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however, is an inference and should be regarded as such.

A. General Description of the Geology and River Regime

Throughout the 93-mile stretch of the Iron Gates, the Danube cuts across the Southern Carpathians in a series of gorges and basins. The broad structural features of the Southern Carpathians are similar to those of the Alpine-fold mountains of other parts of Yugoslavia, where great and complex overfolding and intense faulting have occurred. A cross section of the cleft cut by the Danube across the Carpathian system clearly shows this folded structure, and the gorges provide the finest example in Europe of a defile incised by fluvial erosion. The Iron Gates also illustrate on a large scale a characteristic and widespread feature of the Balkan Peninsula -- the linking together of the drainage of former lake basins through interconnecting gorges cut at the close of the Tertiary age.

Between Ram, 33 kilometers up stream from Golubac (Km. 1,045), in the west and Kladovo (Km. 935) in the east, the Danube descends from 230 to 130 feet above sea level.* Consequently, even the average

* Kilometrage is measured from Sulina, Rumania, at the mouth of the Danube.

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gradient in the Iron Gates is far greater than that in the Hungarian Basin to the west or in the Rumanian Basin to the east. The volume of the Danube varies greatly from season to season, and navigational difficulties are concomitant with both high and low water. Local variations between mean high and mean low water is between 29 and 36 feet. The average flow of the river at the lower end of the Iron Gates is 205,000 cubic feet of water per second. For comparison, the Potomac at Point of Rocks, Maryland, has an average flow of only 11,560 cusecs and an absolute maximum, recorded only once, of 480,000 cusecs.

The gorges (see Areas I-IV on the map) are the primary concern of this study. From west to east they are:

- I. The First Gorge
- II. The Upper Djerdap (Derdap) Gorge
- III. The Kazan (Lower Djerdap) Gorge
- IV. The Sip Gorge (including the Iron Gate)

B. The Gorges of the Iron Gates

I. The First Gorge

About four miles below Golubac, where the Danube passes through the first defile, the river bed narrows to a width of 1,050-1,200 feet. The gorge is about 5 miles long, and on the Yugoslav shore the walls rise almost sheer from the surface of the river to a low plateau about 1400 feet high. On the Rumanian side the walls slope more gently and do not exceed 1,100 feet in height. The gorge is carved through a variety of crystalline rocks. At its upper end is the cherty limestone rock of Babakaj, which stands out several feet above the surface of the water, and at its lower end is the Stenka barrier, a submerged granite reef. To make the Stenka cataracts navigable, over a mile of the channel was dynamited to a width

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-4-

of about 800 feet.

The first gorge ends at the Stenka cataracts, and for the next 10 miles the Danube flows through the Liubcova Basin, which varies in width from 2,700 feet to almost a mile. The basin is made up of various types of crystalline, which are covered with Tertiary rocks to a large extent.

II. The Upper Djerdap (Derdap) Gorge

Just below the bend of the Danube at Bârzaca (Km. 1017) the second cataract, located at the slate bank of Kozla and the reefs of Dojke, marks the beginning of the second gorge. Here the river narrows to less than 1,000 feet. For a distance of 8 miles the Danube has cut a gorge only 600 to 900 feet wide through the highest peaks of the South Carpathians, whose walls rise sharply from water level to altitudes of over 1,600 feet on either side. Here the river has cut through various types of rocks that include limestones and shales, as well as ancient crystalline schists.

The bed of the Danube is interrupted by several rock bars that are exposed only at low water. From northwest to southeast they are:

- (1) Kozla and Dojke, composed of light, splintery Neocomian limestone,
- (2) Izlas and the Tahtaljas, composed of quartz porphyry conglomerates;
- and (3) Vrani, below Greben (Km. 999) which is Tithonian limestone.

Greben, itself, is a great out-thrusting rock 625 feet high (see Figure 2). Channels with widths of 200 feet and lengths varying from 1 to 2 miles have been blasted through these barriers.

Below Greben the valley opens into the Miocene Basin of Donji Milanovac (Km. 993). The basin is about 8 miles long and over 1 mile in breadth at its widest point. At the lower end of the basin is the rock

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-5-

bar of Juc (Km. 989), which is composed of serpentine. Navigation follows a 4,400 foot channel blasted through the barrier.

III. The Kazan (Lower Djerdap) Gorge

Below Juc the valley narrows progressively to its third and most spectacular gorge, which is located at the point where the river course changes from southeast to northeast. Near Kazan (see Figures 3 and 4), the river is restricted to a width of 600 feet, the width of the Potomac at the Georgetown Reservoir. For a considerably longer stretch the width is less than 1,500 feet, approximately that of the Potomac at Memorial Bridge. The narrowest parts of the third gorge are (1) the Great Kazan defile, located between Kazan and Dubova (km. 970), beyond which the valley widens into a small Helvetian basin 1,800 feet in breadth, and (2) the Little Kazan defile (see figure 5) between Dubova and Ogradina. Both defiles have been cut through Tithonian limestone. In this stretch the Danube is about 60 feet deep, the current is characterized by eddies that have scoured out a number of large pot holes in the river bed. Many of the pot holes are as much as 160 feet deep, with their bottoms points below sea level. The Kazan gorge has the form of a canyon sunk within an ancient valley, whose floor today forms a clearly defined platform or terrace that slopes gently back from the precipitous walls of the defile. On the Rumanian side, several small tributaries enter the Danube through normal valleys. There are no right bank tributaries since the gorge is cut into the northern end of a broad outcrop of limestone, which forms a miniature karst plateau that is completely devoid of surface drainage.

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The third gorge ends at the Islet of Ogradina (Km. 962), which is composed of sand and gravel washed down from the Kazan. Between Ogradina and another islet of similar formation, Ada Kaleh (or Adakale, Turkish for Castle Island), is the Orșova Basin, where the Tertiary rocks are less resistant than those of other parts of the Iron Gates. As in the other basins, the Danube hugs the southern banks on the Yugoslav side and the valley walls rise steeply. On the Rumanian side the river is bordered by valley flats and plains of small tributary deltas and the valley walls slope upwards. At many points in the Orșova Basin the river is more than a half mile in width. At the town of Orșova (Km. 956), the Cerma River, the only large northern tributary of the Danube in this section, has cut a deep valley that forms an important natural route into the heart of the Carpathians.

IV. The Sip Gorge and the Iron Gate

The last gorge of the Iron Gates begins just below Ada Kaleh (Km. 950), although it includes the Iron Gate itself, this gorge is less spectacular and wider than the Kazan defiles. Even at Sip, the river is more than 1,500 feet wide, and the valley walls are low and gently sloping (see Figure 6). The Sip Gorge is cut in steeply inclined and almost vertical schists, limestones, and sandstones. Traces of Tertiary lake terraces are found at considerable altitudes above the gorge itself. Just above Sip there is a very large rock bar in the river bed--the Prigrada--which interferes seriously with navigation on the Danube. Strictly speaking, this rock bar is the Iron Gate (see Figure 7). The Prigrada is a great reef, over 5,500 feet long and 1,600 feet wide, that extends almost completely across the river. At low water the reef rock stands above the surface of the Danube and forms rapids, but at high water it is completely

submerged. Deep pot holes have been abraded in the Prigrada, one of which has a depth of 170 feet the last 53 being below sea level.

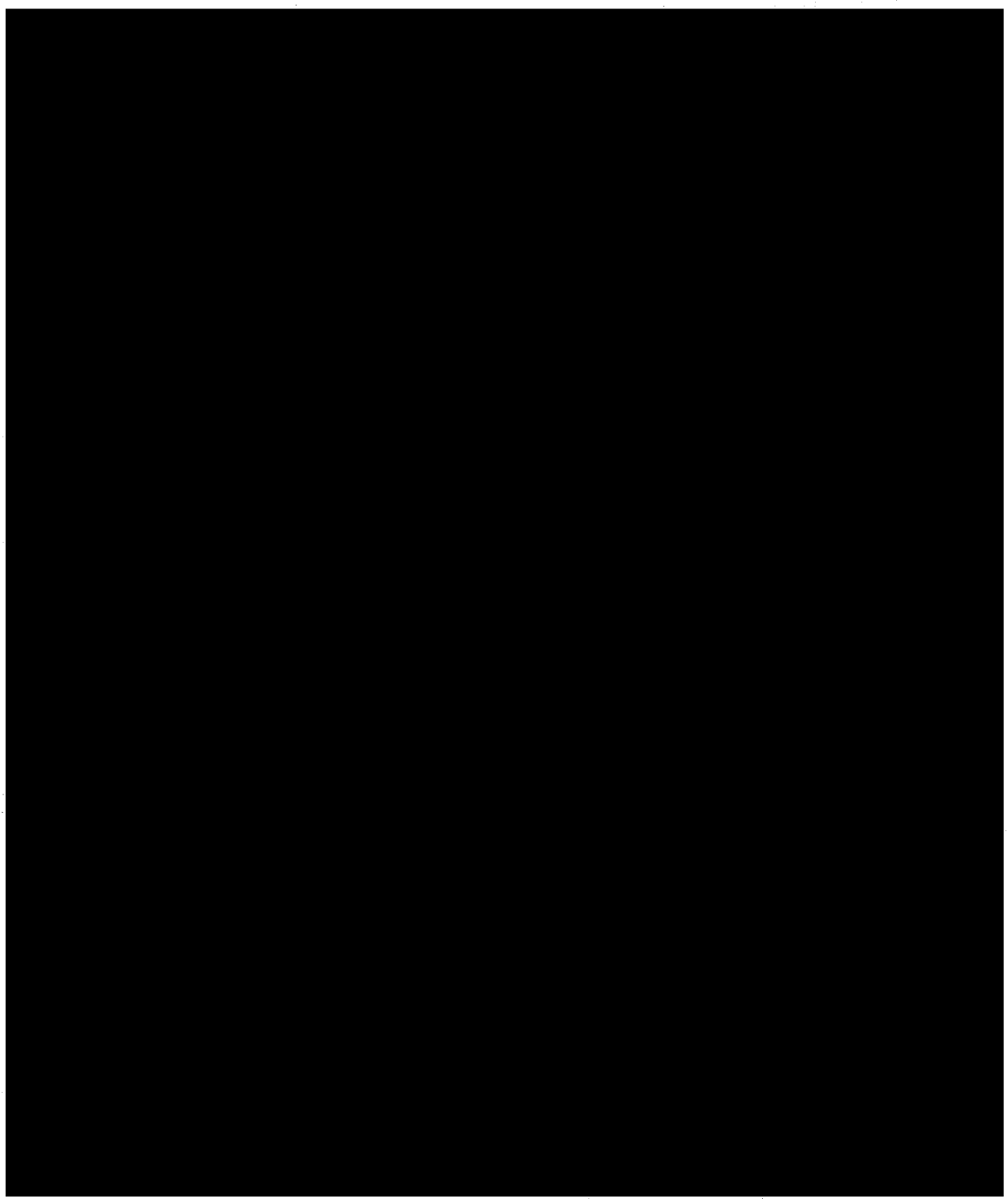
Navigation across the Prigrada has been made possible by blasting the Sip or Iron Gate Canal along the Yugoslav bank. The canal is 262 feet wide and 1 1/3 miles long (see Figure 8).

Even though the other gorges are narrower, more canyon-like, and more awe-inspiring than Sip Gorge, with the Iron Gate, this stretch is the greatest navigational bottleneck along the Danube. In the Sip Gorge, the river, has a fall of about 16 feet, and in October, the low-water season, the current runs up to 12 knots. Upstream navigation through the Sip Canal is possible only with the aid of auxiliary haulage, using steam-locomotive traction. Tows proceeding upstream consist of the steam locomotive and a powerful tug that pull three barges at the most. Along the left side of the Prigrada an old, unimproved navigation channel that at certain water levels is practicable for tows for periods aggregating 116 days a year. These periods, however, occur at various times throughout the year, and the passage, at best, is dreaded by Danubian pilots.

A short distance downstream from the Iron Gate is the Little Iron Gate (Km. 943), a group of rocks in the middle of the river that form a minor hazard to navigation. They are composed of biotite-bearing quartzite and foliated, fine grained granite. The eastern flank of the Carpathian system lies several miles downstream from the Little Iron Gate, and beyond it the landscape begins to change. Sandy islands appear in the river, which is slightly incised into the soft deposits that cover the region generally. The relief is subdued, the hills recede, and the river flows within series of river terraces carved in the less resistant types of

Tertiary rock and Recent deposits. These terraces are the sites of the towns of Kladova and Turou Severin, which mark the eastern limit of the Iron Gates.

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APPENDIX A

SOURCES AND EVALUATION OF SOURCES

1. Evaluation of Sources

All the sources listed below are accurate and reliable. In the list of documents, Items 1, 2, 8 and 10 may be considered primary sources since they are, for the most part, based on field work by their authors in the area of the Iron Gates. Although more than 40 years old they are still the best authorities. The other sources are secondary or tertiary.

All four maps listed are recommended as authoritative, highly informative and reliable. The first three stem from official sources.

2. Sources

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- (3) Sevastos, Romulus, "Sur le Défilé des Portes de Fer et sur le Cours Inférieur du Danube," Bulletin de la Société Géologique de France, 4th series, Vol. 4, No. 5, 1904, pp. 666-678.
- (4) Naval Intelligence Division, Jugoslavia, Vol. I, 1944, and Vol. III, 1945.
- (5) Toula, Franz, "Über der Durchbruch der Donau durch das Banater Gebirge," Vorträge des Vereins zur Verbreitung naturw.

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(8) Barliari, P., Gros, L., et al., Rapports de la Commission
Composée des Ingénieurs Étrangers, Nendtirsch, Gusztáv, Budapest, 1879.

(9) Edwards, Lovett F., Danube Stream, London, 1940.

(10) Gonda, Béla, von, Die Regulierung des Eisernen Thores,
Budapest, 1896.

b. Maps

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(3) Plans et Dessins Annexés aux Rapports de la Commission
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(4) Az Alduna Geologiai Térképe a Hajózási Adakályok Átnézetével,
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