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JANIS 40
CHAPTER II

02

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JOINT ARMY-NAVY
INTELLIGENCE STUDY

EUROPEAN U.S.S.R.

MILITARY GEOGRAPHY

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Chapter II

MILITARY GEOGRAPHY

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20. INTRODUCTION

This chapter describes the terrain of European USSR, with emphasis on relief, drainage, vegetation, and trafficability of surface materials. A brief description of JANIS 40 area as a whole is followed by a more detailed description by regions.

The Plans and Figures are an integral part of this report and full use must be made of them in order to obtain an adequate view of the various parts of the country and their differences. PLAN 1 is a general reference map. On PLAN 2 the boundaries of regions and subregions are shown, and the locations of all photographs contained in the chapter are indicated. A study of this map is necessary for an intelligent reading of the text; it should also be referred to constantly when examining the photographs. PLAN 3 pictures the general physiography of this JANIS area. The drainage pattern of streams, lakes, swamps, and marshes is shown on PLAN 4, and on PLAN 5 vegetation, classified by types, is shown in areal distribution. General trafficability of surface materials is depicted on a series of four plans, PLANS 6 to 9; since trafficability varies greatly with the seasons, the maps represent trafficability conditions during spring, summer, autumn, and winter, respectively. PLAN 10 gives further data regarding trafficability, showing the areas of mud as of 1 April and as of 1 May.

Detailed maps are included for only three regions and one subregion. PLAN 11 is a hypsometric map of the Volga-Caspian Desert Region (Region C) on which drainage and transportation lines also are shown. For the Ukrainian Carpathian Mountain Region (Region D) there are two maps, FIGURES II-94 and II-105, one showing primarily routes through the mountains and the other being a hypsometric and drainage map. FIGURES II-152 to II-154 are of the Mountainous Crimea Region, giving details of relief, drainage, surface configuration, and vegetation. FIGURE II-33 is a detailed map of subregion B-1, Kola-Karelian Hills and Lowlands.

A brief description of the features discussed in this chapter is given under Topic 2 of Chapter 1. The bare essentials of terrain information are recapitulated tabularly under Topic 23 of Chapter II. The principal sources consulted in the preparation of this chapter are indicated and briefly evaluated under Topic 24. It should be noted that all distances cited in this chapter are in statute miles.

21. GENERAL DESCRIPTION OF THE AREA AS A WHOLE

The basic reference maps for this topic are PLANS 2 to 11. These should be studied concurrently with the text.

A. Introduction

European USSR comprises 1,659,000 square miles, equivalent to approximately 55% of the area of the United States (excluding possessions) or about 50% of the land area of Europe. The country is roughly rectangular in shape; somewhat longer from north to south than from west to east. For example, it extends over 1,700 miles from the naval base of Sevastopol' in southern Crimea to Polyarnyy, the naval base on the Arctic Ocean. Klaipėda, on the Baltic Sea in the west, lies over 1,300 miles from Sarapul near the eastern border of the JANIS 40 area.

The landscape of European USSR is monotonous from one end of the country to another. There is little relief, except locally. Only a few small districts have elevations over 1,000 feet. Drainage pattern and characteristics are similar throughout. There are, however, large-scale differences in vegetation and the capability of surface materials to support heavy traffic. These terrain features were used to divide the JANIS 40 area into seven terrain regions (PLAN 2).

In this chapter we shall examine the geographic characteristics first of the area as a whole (TOPIC 21) and secondly of the regions (TOPIC 22).

B. Relief

(PLANS 2 and 3)

The most significant geographic feature of European USSR is the extensive plain with an almost total absence of relief, in contrast to the rest of the European continent. However, lowland sections frequently alternate with more elevated and more strongly dissected sections, locally termed heights or hills. These eminences lie mainly over 600 feet above sea level, only a few districts being more than 1,000 feet. Since the general level of the plain, however, is about 550 feet, few of these eminences rise more than 670 feet above it.

One of the breaks in this level-appearing plain is found in the Southwest Russian Upland (C-2) which is deeply cut by numerous valleys 150 to 400 feet deep. Also, trending northwest - southeast across this upland there is a

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series of granite outcrops which forms a kind of elongated plateau, with elevations 900 to 1,100 feet above sea level, and continues as disconnected low hills as far south as the Sea of Azov (Azovskoye More).

In the central part of the JANIS 40 area there is another series of uplands or elevated sections trending north-south. In its northern extent it is known as the Eastern Hills (B-1c). Southward, successive parts are recognized as the South Valdai Hills (C-1c), with elevations from 650 to 1,062 feet; the Central Russian Hills (C-3b); and the Donets Hills (E-1d), where a maximum elevation of 1,220 feet for the series is reached southwest of Voroshilovgrad.

Eastern elevations known as the Pre-Volga Hills (C-3f and E-2b) are in reality a north-south trending plateau with an elevation above sea level of about 1,000 feet. It extends from Kazan' to south of Saratov and dominates the right bank of the Volga river either as high cliffs or as bluffs. In the northeastern part of the JANIS 40 area are the Khrebet Pay-Khoy and the Timan Hills, each group consists of a series of northwest-southeast trending ridges which do little to retard cross-country movement.

The major highlands of this JANIS area border the great plain and thus do not break its continuity. These highlands are, the Ukrainian Carpathian Mountains (Region D) in the southwest, the old and much worn down Kola-Karelia Low Mountains (B-1a) and the rough, rocky land of Karelia (B-1b) in the northwest, a 300-mile segment of the Northern Urals (B-2e) in the northeast, and the southern mountains of Crimea (Region F-1). All of these major relief features are considered "barrier frontiers" bordering the plain.

Elsewhere throughout European USSR there are wide expanses of level-to-rolling plain. However, wide areas of swamps and marshes do much to affect cross-country movement. These terrain features are discussed in Topic 21, C. Despite European USSR's vast extent from the Arctic Ocean to the Black and Caspian Seas and from the Carpathians to the Urals, the plain retains its integrity and low elevation above sea level. Its mean altitude is only about 550 feet.

C. Drainage

(PLAN 4)

The rivers of European USSR are typically long, many on its great plains extending 1,000 miles or more; they have low gradients (average 4.6 to 7.8 inches per mile) and shallow valleys. Many miles of their courses are bordered by marshes or swamps. The mountain borders of parts of European USSR have relatively little effect on the rivers of the area. Several important rivers rise near each other on the flattish tops of the Valdai Hills and follow divergent courses. These radiating streams include the Volkhov, whose waters flow northward to the Ozero Il'men'; the Daugava (Zapadnaya Dvina), flowing west to the Baltic; the Dnepr and Don whose courses are generally south to the Black Sea; and the Volga, the greatest of European USSR's rivers, which trends southeast and discharges into the Caspian Sea. Another flattish divide separates the northern tributaries of the Volga from the rivers flowing northward to the Arctic Ocean. Important among the latter are the Onega, the Northern (Severnaya) Dvina, the Mezen', and the Pechora.

So nearly level are portions of both of these divides that during spring flooding there is often a temporary sharing of water between the diverging streams. Canals have been built connecting various of the streams whose headwaters are adjacent; Moscow is now connected by shallow-draft canal to all seas bordering European USSR, and a network of larger capacity is under construction.

The country has a great number of unevenly distributed lakes. The greatest concentration is in the Kola-Karelia lake region; the largest ones are Lake Ladoga (Ladozhskoye Ozero) and Lake Onega (Onezhskoye Ozero). In the grassy lands of the south the few lakes are insignificant in size except on flood plains where some areas submerged in spring floods remain shallow lakes throughout the year. In addition, there are lagoon- and estuary-type lakes along the shores of the Black Sea and Sea of Azov (Azovskoye More) and salt lakes in the Caspian Lowlands.

Marshes border many of the lakes and connect them with adjacent water bodies. In the forested belt and northward, swamps cover wide lowland areas. South of the forested belt, marshes are mostly along streams. It has been estimated that swamps and marshes cover about 6.8% of the total land surface of European USSR. The most extensive marshes are those bordering the Pripyat' river.

The main high-water period is in the spring and early summer (April to June), following the winter snow melt. Streams overflow many of their banks, extending the borders of swamps and marshes. Ground water is available everywhere, but in general it becomes deeper and more mineralized from north to south. Bordering the Arctic, for example, ground waters lie close to the surface, are almost completely lacking in mineral salts, and have a high organic content. Ground waters in the Black Sea area lie at great depths (in part deeper than 1,000 feet) and on the whole are very hard, saline, or brackish.

During the cold season the water bodies of nearly all of European USSR are covered with ice. The ground, too, is frozen or snow-covered and drainage is practically at a standstill. This period of ice cover varies in duration from less than two months in the southwest on the lower Dnestr to seven months in the northeast on the lower Pechora. Thickness of ice varies from a few inches in the south to over 3 feet in the north. Since subfreezing temperature is required for the freezing of salt water, duration and thickness of ice on the salt lakes and the Caspian Sea vary with salinity.

D. Vegetation

(PLAN 5)

The latitudinal extent and position of European USSR – comparable to that of the area from St. Paul, Minnesota, to beyond the Arctic Circle – give the country a wide variety of vegetation. Zonation in a broad sense is definite, with fairly wide areas of transition. Vegetation ranges from the tundra type in the north to the Mediterranean forest in southern Crimea and to dry desert forms of vegetation in the Caspian Lowlands. Forest and grass, however, are dominant.

For approximately a hundred miles inland from the Arctic coast is the tundra, most of whose subsoil remains permanently frozen. Its dominant vegetation consists of lichens and mosses. This zone is similar to the Barren Grounds of Canada. On its southern margin, however, are associations of berry bushes and sedges, and also dwarf trees such as birch, willow, and various conifers. Southward, but mainly north of a line from Leningrad to Molotov (Perm), the trees gradually become numerous and taller. This is a transition zone.

South of the Leningrad - Molotov line the growth of trees becomes dense and forms an immense forest of conifers mixed with birch. This coniferous forest belt, spreading across European USSR from west to east, extends southward for about 600 miles.

Farther to the south, but mainly north of a line from Kiev to Kazan', the dominant conifers are replaced by broadleafed trees such as oak, beech, ash, and maple. Here, except in the swampy district of the Pripyat' river, much of the forest has been cleared to provide cropland and meadows. Crops include small grains, flax, sugar beets, and vegetables.

Extending across the southern part of this JANIS area is a vast grassland (steppe) on which trees are either absent or rare. The grasses vary from tall feathergrasses in the north to shorter and progressively wider-spaced, tufted grasses in the south. Much of this area is now under cultivation.

West and north of the Caspian Sea, and on both sides of the lower Volga, the grasses become sparser, and in places saline. There are also low-growing wormwood shrubs common to desert regions. Only along the moist Volga flood plain are there trees and thick grasses and reeds. Cultivated areas are confined mainly to the flood plain.

The marginal mountainous parts of the country are mainly forest covered. The trees include fir, pine, spruce, oak, beech, and chestnut. Above timber line there are mountain meadows and some areas covered with mosses and lichens.

E. Trafficability of surface materials

Trafficability of surface materials as used in this JANIS means the ability of surface materials in their natural state to support vehicles moving either across country or on unimproved roads made entirely of local soils, and in some instances to support troops, cavalry, and cargo animals. The principal criteria used in determining trafficability of surface materials in this JANIS are the areal distribution of soil textural types and weather records which give the seasonal distribution of precipitation and the critical isotherm of 32° F. These data are shown on PLANS 6 to 9.

The northern part of the country is covered with coarse-to-fine soils of glacial origin; the southern part is covered with deep layers of fine-textured loessal, residual, and alluvial soils. In general, the surface of European USSR can be divided into four broad soil types. These are: 1) the well-drained, sandy and loamy soils over unconsolidated materials which are trafficable at all times except during heavy rainfall, 2) the moderately drained deep, loamy, and clayey soils over consolidated materials which are nontrafficable during and for a considerable time after heavy rainfall, 3) alluvial and other fine-textured soils that contain well and poorly drained soils intimately associated, and 4) poorly drained soils. The last two types are nontrafficable except when firmly frozen.

Caution is urged in the use of PLANS 6 to 9, as they give an over-all view of soil types and trafficability, rather than detailed information for any one place. It must be remembered, too, that certain areas have their local limitation on cross-country movement, even though the trafficability maps may show them as areas of favorable drainage. Such areas include the Carpathian, Ural, and Crimean mountains, the Khibinskaya and the Lovozerskiye tundras, the gullied areas of southern USSR, the rocky portions of the north, the extensive bog and marsh areas of the west and north (PLAN 4), and the saline soils of the Caspian Lowland.

Trafficability throughout most of European USSR is affected by climate rather than by terrain. Least favorable trafficability conditions occur in the spring, when even improved roads commonly fail in spots. Steady melt begins about 1 March in the vicinity of the Black Sea and the melt period moves from west and south to the northeast. During this period little if any cross-country movement is possible. Another unfavorable period for cross-country movement is in October and November, when alternate periods of freezing and thawing of the surface soil disrupt the normal soil-drainage before the onset of persistent freezing. Any precipitation or freezing temperatures during this period make for poor trafficability, by the formation of deep muds or frozen ruts, which are detrimental to tires and springs of vehicles.

Winter is the most favored period for widespread cross-country movement. Surface materials are frozen deeply enough in normal years to support most military vehicles. Winter ranges from December to March in the south, and from October to the latter part of May in the north. January is the coldest month throughout the country. During the season of continued frosts, depth of frozen surface materials varies from none in the extreme south to 40 or 60 inches in the central and northern portions. Maximum depth of frost penetration is highly significant, since it is directly related to duration of nontrafficable conditions in the spring. For example, frost penetration of 6 inches may be associated with poor trafficability of only two to four days when thawing occurs but frost penetration of 36 inches or more ordinarily results in nontrafficable conditions from four to seven weeks (PLAN 10). Lakes, ponds, rivers, and most swamps freeze over during October and November and become trafficable until the spring break-up.

In summer, surface materials of European USSR are generally trafficable. However, trafficability from day to day during the summer depends upon frequency, intensity, and duration of rain and the higher rate of evaporation. Even in summer, in such places as the Pripet Marshes, areas east of Leningrad, much of the Northern Forest and Tundra Belts, and on river flood plains, local routes will have to be chosen with care. Elsewhere cross-country movement should be feasible during summer except during or immediately after heavy or prolonged showers.

F. Military implications of the terrain features

Insofar as the surface configuration is concerned, cross-country movement is feasible in most places. However, it may be prevented or retarded by: 1) the steep escarpments on the west banks of the large rivers, 2) the wide river flood plains bordering most of the streams, 3) an extensive network of deep gullies and ravines in the southern part, and 4) rock-strewn areas in the northwest.

Greater deterrents to cross-country movement than relief are: 1) the drainage net throughout the country, 2) the vast, poorly drained areas which are covered with bogs, swamps, and marshes, and 3) the numerous lakes in the west and north. However, the barrier effect of the streams and lakes is greatly reduced in midwinter when most are firmly frozen. In fact, the ice on Lake Ladoga was used as the major supply route to Leningrad in World War II when all land approaches had been blocked. The major rivers are serious barriers during the spring flood periods and temporarily in summer following any excessive rain. Both the Germans and the Russians crossed the Dnepr

and Don after some preparation, but relief irregularities and swampy bottomlands channelized all approaches to these rivers.

On an area of slight relief, variation in vegetation becomes of primary importance in such aspects of military operations as cross-country movement, deployment, and concealment. In the north, the low moss, sedge, and scrub trees of the tundra offer few obstacles to movement and only limited possibilities for concealment and fuel supply. Southward from the tundra, the great forest belt, although interrupted by marshes, moors, and scattered man-made clearings, is a serious barrier or impediment to movement but offers maximum concealment and an unlimited supply of wood.

In the transition zone between the forest belt to the north and the grassland to the south, there is no open area which cannot be dominated by fire and observation from adjacent forested areas. Here movement would encounter alternating openings and wooded patches.

In the vast grassland belt, cover and concealment are poor. Concealment is possible only in crouching or prone positions.

Insofar as trafficability of surface materials is concerned, the most favorable season for movement is in winter (December - February) when most surface materials (including lakes and bogs) are firmly frozen. However, low temperatures and snow would hamper free movement of personnel and equipment. Another favorable period occurs in summer (June to October) when most surface materials are dry. Least favorable periods for movement are during spring (March to mid-May) and autumn (October and November) when deep mud covers most of this JANIS area.

22. DETAILED DESCRIPTION OF REGIONS

Since the surface of European USSR is so regular, chief regional differences are due to vegetation. As a result, vegetation was the basis for delimiting the Tundra Belt (Region A), the Northern Forest Belt (Region B), the Forest and Clearings Belt (Region C), and the Grassland Belt (Region E). The Volga - Caspian Desert (Region G) was determined on the basis of climate. Only the Ukrainian Carpathian Mountains (Region D) and Mountainous Crimea (Region F) were determined on the basis of relief. Each of these regions is discussed on the basis of relief, drainage, vegetation, trafficability of surface materials, and the military significance of each terrain feature.

A. Region A, Tundra Belt

(1) Introduction

The Tundra Belt extends along the entire Arctic coast of European USSR from the Norwegian boundary to the low northern extension of the Ural mountains and the Kara river (PLAN 2). For the purposes of this study the Tundra Belt Region includes the Arctic islands close to the USSR coast, i.e., Kolguyev, Vaygach, and several smaller islands. This region has an irregular shape, extending about 900 miles from west to east but its north - south width varies from 25 to 200 miles. The total area is approximately 120,000 square miles, about equal to the area of New Mexico.

The lake-strewn, rocky upland surface on the west, the Northern Urals on the east, the dense forest belt to the south, and the icy Arctic Ocean to the north, combine to make this Tundra Belt difficult of access as far as land or water routes are concerned.

Few roads or railroads are found within the Tundra Belt. The Guba Pechenga (Petsamovuono), with its ice-free port of Liinakhamari, is the Arctic terminus of a gravel-surfaced highway from Rovaniemi (Finland) (330 miles), where it connects with the railroad to Kemi at the head of the Gulf of Bothnia. Kol'skiy Zaliv, with the ice-free port of Murmansk, is connected with Leningrad by the Murmansk railroad. A military road was constructed between Murmansk and Liinakhamari during World War II. East of the White Sea, a 1,000-mile extension of the Soviet railroad system was built during World War II to connect Kotlas and the coal mines at Ust'-Vorkuta and Khabarovo, a small port on the Yugorskiy Shar strait. This railroad crosses the great Pechora river, which is navigable to boats in summer throughout subregion A-2.

The Tundra Belt, as defined here, includes not only the low, mossy, and lichen-covered areas and bare rock ridges near the Arctic Ocean, but also a strip of mixed lichen and scrub tree vegetation farther south which forms a transition zone between the treeless tundra on the north and the extensive Northern Forest Belt (Region B) on the south (PLAN 2). The tree-tundra zone is included because the widely spaced patches of short scrub trees, 6 to 15 feet high, merely form islands one half to 10 miles apart amid the predominant, low tundra vegetation.

Within the Tundra Belt varied types of terrain are found. They include low, narrow coastal plains, river lowlands, extensive marshy areas, hilly ridges, dissected upland or plateaulike surfaces and steep-sided ravines (PLANS 2 and 3). By far the greater part of the terrain is flat-to-gently-rolling. There are no mountains within the Tundra Belt, but there are widely scattered hills or hill chains such as the Timan Hills or ridges and Pay-Khoy hills. None is sufficiently rugged, steep, or compact to constitute a major obstacle to any kind of military operations. Steep slopes are confined largely to coastal bluffs and sides of river valleys which are typically deep-cut, especially west of the White Sea (Beloye More).

By far the best staging areas lie east of the White Sea; but here minor relief features greatly affect cross-country movement. These features consist of frost bulges and peat mounds in bog sections. In places these mounds are many feet high. Detailed information on their local distribution is lacking. In addition, extensive marshes and moors also have a major effect upon cross-country travel. Trafficability is best during winter, when most marshes and moors are frozen firmly and blanketed by snow. Although the total snowfall is not great, a thickness favorable for travel accumulates rapidly.

Poor surface drainage of level areas during early summer is caused by frozen subsoil. This greatly restricts normal ground operations for all types of equipment throughout the Tundra Belt, limiting movement to foot travel, to light pack animals such as reindeer, or to the waterways. There are large areas of Canada with similar conditions.

The Kola Coast Tundra, west of the White Sea, is drained by comparatively short streams, many of whose valleys are gorgelike (PLAN 4). East of the White Sea, the Trans - White Sea Tundra is drained by hundreds of streams, most of which are unsurveyed. Most streams present obstacles to cross-country movement either by their gorgelike character in the east, or wide, and in many places marshy, flood plains in the west. In winter, however, frozen surfaces of streams assume an added, im-

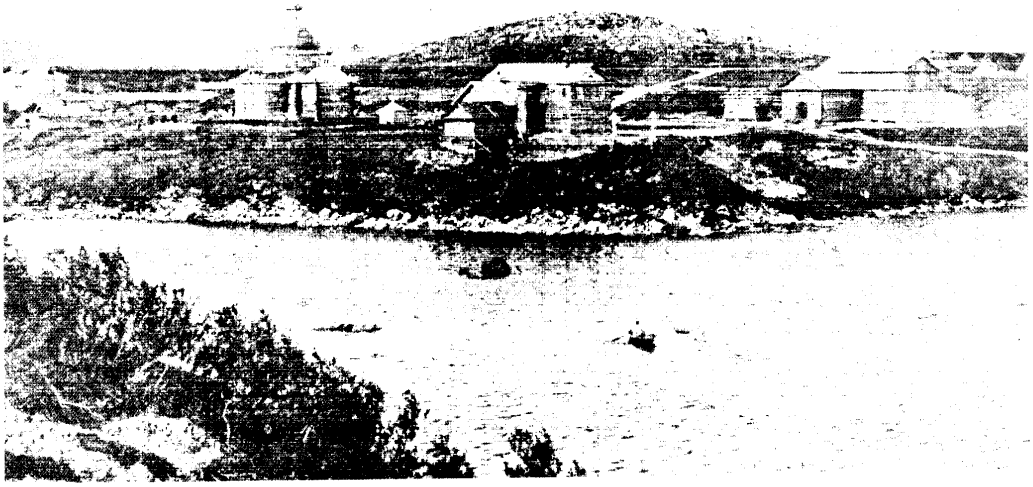

FIGURE II-1. *An isolated village on west bank of the Guba Pechenga (Petsamovuono).*
Direction unknown. Usually small fishing villages of wooden construction occupy such sheltered terraces in fiords. Before 1900.

portant aspect, for they provide easy access to a region otherwise poor in transportation routes. The numerous lakes and extensive marshes and moors which retard or restrict movement in summer become trafficable for some types of vehicles during the period of continued frosts.

There are few annual plants in the tundra zone. The dominant flora consists of mosses and lichens (PLAN 5). Dwarf shrubs grow only to the average height of the protective snow cover. Height of woody growths increases southward. Bushes and trees are found to be sheered off at snow level by the action of frost and dry winds. Slow-growing evergreen shrubs also are found in the southern portion of the Tundra Belt; for example, a juniper trunk three inches in diameter may be 500 years of age. Grasses cover large tracts of higher and drier ground and river plains. There is practically no vertical or horizontal concealment possible in the tundra. Food resources are scarce or lacking.

Soils of the Tundra Belt are dominantly of glacial or marine origin and range from heavy glacial clays to light sands. In addition, there are large areas of bare, smooth rock surface without any soil, other than a thin layer of decomposed rock. There are numerous boulder-strewn areas, and large expanses of marsh and bog.

In spring (May-June) there is a muddy period during the melting of the snow and for two or three weeks afterward. Travel is possible only in rocky regions at this time (PLANS 6 and 7). Warmth in the short summer season is not sufficient to dry out the ground in the low areas. Peat marshes generally remain impassable even in late summer and autumn (PLAN 8). A short mud period just before the period of continued frosts greatly restricts movement, particularly in river valleys having clay soils. In winter most surfaces, including bogs and marshes, are covered with a layer of ice and snow (PLAN 9). This layer, however, cannot support the same amount of weight as ice on streams. Most frozen marshes can support animal-drawn sleighs but can be traversed by motor vehicles to only a limited extent.

(2) Subregion A-1, the Kola Coast Tundra

(a) Relief (PLANS 2 and 3).—The Kola Coast subregion of the Tundra Belt (A-1) extends in a northwest-southeast direction for about 300 to 350 miles across the northern portion of the Kola Peninsula. In the west it occupies a coastal zone about 50 miles wide. Eastward the belt narrows to about 25 and 15 miles in width in the valleys of the Zapadnaya Litsa and Ura rivers respectively. Farther eastward the zone widens and includes the entire basins of all the north-coast rivers and the middle and lower portions of the Ponoy and Purnach rivers. South of 66°30′ N, and between 40° E and 38° E the tundra occupies only a narrow 5- to 10-mile-wide coastal strip. The Kola Coast zone covers some 20,000 square miles, or about twice the area of Vermont or New Hampshire.

Within the Kola Coast Tundra varied types of terrain are found, including low, narrow, coastal, and river lowlands, dissected upland or plateaus, poorly drained depressions, hilly ridges, and steep-sided rocky ravines.

In general the Kola Coast Tundra (A-1) is a level-to-hilly, rocky plateau 600 to 700 feet high, which declines gently to the southeast, but drops precipitously to the sea or to narrow beaches along the northern coast. This entire coast is lined by steep, almost barren granite hills and vertical cliffs. The coast, particularly west of (Kol'skiy Zaliv), is indented by many bays and inlets, and bordered by steep, cliffy granite formations. The coast as far south as Sosnovka is steep and rocky except for isolated low areas at the heads of bays and lowlands at the mouths of rivers. Such places as a rule are the sites of small fishing villages (PLAN 4 and FIGURE II-1). Occasional heights of 300 to 700 feet furnish excellent observation sites. Rivers reach the coast in deep valleys cut through the granite hills and do not furnish easy access inland (FIGURE II-2).

Southwest of Sosnovka the coast changes from steep granite cliffs to shores lined by steep clay banks about 40 feet high, interrupted by granite promontories. A few low. sandy, marshy areas exist at river mouths. Elevation of the terrain increases rather gradually inland. A detailed description of this coastal area is given in Chapter IV, 41, C, D.

The Rybachiy - Sredniy peninsula west of the Kol'skiy Zaliv, and Kil'din island east of it, differ physically from

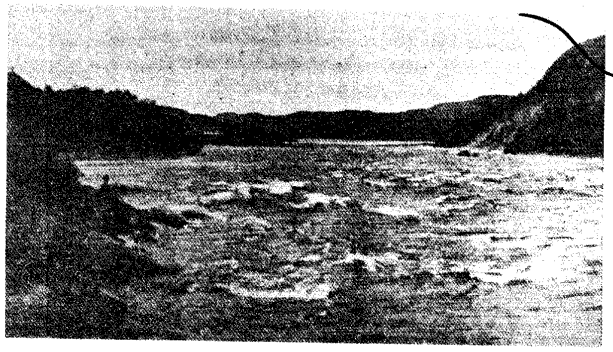

FIGURE II-2. *Steep rocky banks bordering the Pats-Yaki (Patsjoki, Pasvikelu).*
Direction unknown. This river forms part of the boundary between the Soviet Union and Norway. Rapids are typical of all rivers between the Soviet-Norwegian border and the Kola river. These rapids restrict movement in all seasons; in winter, ice is thin over the rapids. Before 1900.

FIGURE II-3. *Typical rocky upland of the Rybachiy-Sredniy peninsula.*
Extensive patches of bare, loose rock dot the Rybachiy-Sredniy peninsula. Snow persists in sheltered places as late as August. 1928.

the Kola Coast Tundra in that they are composed of rocks which include clay schist, sandstone, and limestone.

The Rybachiy - Sredniy peninsula is connected with the granitic Kola peninsula by a low, narrow isthmus, nowhere above 160 feet in elevation. Much of the Rybachiy - Sredniy peninsula consists of a dissected plateau surface of over 500 feet elevation, which is deeply cut by canyon-like valleys (FIGURE II-3). It is flanked by steep, and in places, sheer cliffs. Maximum elevations of about 900 feet are attained in western Rybachiy and 1,000 feet in the south-central Sredniy. The north coast of this peninsula slopes rather gently to the sea, but the other coasts are steep or cliffed, in places 200 to 300 feet high. Several well-defined shore terraces are found along the coastline, but elsewhere a rather thick mantle of weathered rock and soil gives a subdued outline to much of the relief of the peninsula (FIGURE II-4).

FIGURE II-4. *South shore of Bol'shaya Volokovaya Guba (bay) along the west coast of the Rybachiy-Sredniy peninsula.*
This bay separates the Rybachiy peninsula to the north from the Sredniy peninsula to the south. Escarpments of stratified rock and steep-faced, barren terraces must be crossed to reach the fairly level upland surface. Before 1941.

Kil'din island resembles Rybachiy - Sredniy peninsula in geologic composition. Most of the island is a 900-foot-high plateau that drops to the north and northwest in almost vertical cliffs, at the foot of which is much broken rock and stone. To the east and south the surface slopes in pronounced, broad terraces to Kil'dinskiy Proliv. Deep canyonlike valleys of small streams have cut into the vertical, clifflike borders of the plateau.

In general an irregular coastal strip about 50 miles wide lies along the Murman coast and consists of a plateau 500 to 700 feet above sea level. Elevation increases southward to the drainage divide between the Barents and White Sea tributaries (in subregion B-1). Dissection of the plateau surface is most pronounced west of the Voron'ya (river), and less pronounced in the swamp zone north of the Ponoy (river). There are numerous small bog- and lake-filled hollows.

FIGURE II-5. *Polyarnyy, the base for the Soviet Arctic Fleet, on the Kol'skiy Zaliv (Kola fiord).*
This old photo (July 1899) illustrates a typical fiord between the Petsamo-ioki (Pechenga) and Kola rivers. Snow patches persist well into the summer. Upland slopes are barren and difficult to cross. Note how buildings utilize flat areas.

FIGURE II-6. *Landscape north of Liinakhamari in the Guba Pechenga.*
Looking southward. The upland surface is mostly bare rock littered with loose boulders. There are scattered lakes and moor-filled hollows containing some dwarf birch. Elsewhere vegetation consists of lichen and low moss growths. Before 1941.

FIGURE II-7. *Gubnoy Valley near Mys (Cape) Orlov.*
Looking southward. Deep gorges are common along the Murman coast. The valleys are of little use as routes because of the rocky bottom of the stream beds, and deep snows. 1889.

FIGURE II-8. *Tundra north of the mouth of the Ponoy.*
Low tundra vegetation dominates on the almost level upland surface near the coast. Access to the upland is difficult from the fiorded coast. 1889.

The granite upland, with maximum elevations of 800 to 1,000 feet, between the Petsamo-ioki and Kola rivers, is dissected by several narrow, deep, north - south trending depressions occupied by rivers and or' lakes. These depressions reach the Barents Sea as deep fiords (FIGURE II-5). This section is cut up by a net of deep gorges or troughs intersecting at right angles. Many small rounded, bare upland surfaces between the troughs contain numerous lakes and moor-filled hollows (FIGURE II-6). Any cross-country movement is difficult.

Between the Kola and the Voron'ya rivers, and 30 or more miles inland, a west - east trending ridge Vozvyshennost' Keyvy or (Keyvy Hill Ridge) reaches a maximum elevation of 1,300 feet and crosses the high, relatively flat, lake-dotted plateau. The ridge decreases in height to the east. Southward from this ridge is a swampy, hilly plain 20 to 30 miles wide that contains many lakes, and extends to a second east - southeast trending ridge about 1,300 feet high (approximately on the boundary between Regions A-1 and B-1 on PLAN 2). Near the Voron'ya river the terrain is a rolling plateau, about 800 feet high and merges with the broad valleys of the Voron'ya and Kharlovka rivers and the upper valley of the Iokan'ga river (37° E, 68° N). These depressions could be utilized as through routes to the White Sea. Dome-shaped hills of weathered granite rise over 200 feet above this lowland. The area near Ozero Yenozero (68° N, 38° E) is extremely marshy and contains many lakes and pools. Southeastward from the mouth of the Iokan'ga to the broad valley of the Ponoy river a slightly rolling, stony plateau extends along the coast. Its edge is cut by gorges with vertical slopes, in places as high as 150 feet (FIGURE II-7). Bottoms of the gorges vary from narrow and rocky to broad, flat strips with moors and some lakes. A number of these gorges, or troughs, run parallel to the coast between the long narrow Mys (Cape) Svyatoy Nos and Mys Bol'shoy Gorodetskiy. Inland from the coast the land rises to a gently undulating plateau 660 to 800 feet in elevation which is dotted with numerous lakes, ponds, and pools interspersed with small marshy areas (FIGURE II-8). About 25 to 30 miles inland, elevations increase to about 1,000 feet and the surface is extremely marshy. Southward the plateau surface merges with the broad valleys of northern tributaries of the Ponoy river.

The Vozvyshennost' Keyvy (Keyvy Hill Ridge) extends from northwest to southeast about 125 miles across the interior of the Kola Peninsula and parallel to the middle and upper Ponoy river. This ridge is composed of a chain of broad, granitic, dome-shaped hills separated by deep gorges or trenches. The ridge descends rather steeply to the surrounding marshy plain. Maximum altitudes range to approximately 1,300 feet.

Southeastward the Vozvyshennost' Keyvy narrows gradually and decreases in elevation. Its southern slope descends precipitously to the hilly, lake-dotted, marshy lowland of the middle Ponoy. The northern slope, however, descends more gently. Near the Acheriok river, the eastern end of the Vozvyshennost' Keyvy declines rapidly in elevation and continues as a marshy divide between the Acheriok and Kolmak rivers.

South of the Ponoy river the surface of the Kola Coast Tundra is a plateau only 350 to 500 feet above sea level. Elevation of this low block decreases gradually toward the east and southeast. Toward the south the upland slopes gradually and drops to a low coastal plain along the White Sea. Sand ridges and hills are scattered over this plain. The lower Ponoy and the lower sections of its tributaries have cut deep gorges into the plateau, but portions of the streams flow over the plateau surface through no pronounced valleys.

(b) Drainage (PLAN 4).—The Kola Coast Tundra is drained by comparatively short streams, which for the most part flow directly to the sea. The most striking feature of these rivers is the gorgelike character of their middle and lower courses. Location of these miniature canyons for the most part is determined by fissures in the basic rock structure of the area. Large rapids and some waterfalls are found near the edge of the plateau. Between the Norwegian border and the Kola river, the lower courses of all the rivers flow through true Norwegian-type fiords in the plateau. Eastward from the Kola, the

fiords become less and less pronounced, but the valleys near the coast are nevertheless deep and narrow as far east as the Ponoy estuary. Inland, even the valleys of the smaller rivers and streams generally are broad in their upper courses.

The Teriberka flows north - northeastward through several lakes and empties into the Barents Sea. It is swift, with numerous rapids and some waterfalls. One of the largest waterfalls is four miles above the river's mouth. The right bank is sandy but the left is steeper and rocky. The stream usually is ice covered from the end of October to mid-May.

The Voron'ya rises in Ozero Lovozero, flows northward about 75 miles, and empties into the Barents Sea. The stream bed is rocky and full of rapids, some of which are a mile or two long. Large waterfalls formed by vertical, granite cliffs, also interrupt the stream. The swift, turbulent stream is considered unnavigable even by the local inhabitants. The upper course is ice covered from October to May. Because of the swiftness of the stream and the numerous rapids, it is doubtful whether the ice is strong enough to be used as a highway in winter.

The Iokan'ga flows eastward through the subregion for about 90 miles and empties into the Barents Sea. It varies from 1,800 to 3,000 feet in width near its mouth, and depths are not less than 12 feet in the same area. Rapids begin about 3.5 miles from the coast. The Iokan'ga is not navigable even for small boats. It is ice covered from the middle of October to the middle of May. Over rapids and near all waterfalls thin ice may be expected.

Much of the Ponoy river lies within the Kola Coast Tundra. The breadth of the river varies from 330 feet at Ozero Vuliyavr (subregion B-1) to 1,300 feet above Ponoy village near its mouth (FIGURE II-9). Depths vary from 0.5 to 6 feet. The bed of the river is either sandy or muddy below Ozero Vuliyavr. The immediate stream banks in few places exceed 7 feet in height and are bordered by discontinuous terraces. In the lower (eastern) one-fourth of the Ponoy, rapids are numerous; the last (or lowest) is only 4 miles above Ponoy village. Velocity of the Ponoy in this lower section is from 3.6 to 5.3 feet per second between the rapids. The river is ice covered from October to May except over rapids and near waterfalls.

FIGURE II-9. *Ponoy river at Ponoi village.*
Looking south toward Ponoi village from the upland surface. The immediate banks of the river in few places are more than 7 feet high but a short distance from the river steep bluffs prevent easy access to the undulating upland surface. What appear to be rocks in the river is a fishing fleet. 1887.

On the Kola Coast Tundra there are numerous large, broad, and deep lakes in the abandoned valleys of ancient rivers. One example of such is the series of depressions through which the present Iokan'ga river passes in its winding upper and middle course. Some of the depressions are now completely drained and others contain lakes of varied sizes. Ozero Vuliyavr is a shallow depression of the Ponoy. The larger lakes all lie east of the Voron'ya river.

There are also numerous extensive lake-filled shallow depressions only 2 to 5 feet deep scattered throughout the subregion. Most of these shallow lakes have flat shores but great masses of coarse glacial material rise above the water. The numerous lakes are serious obstacles to cross-country movement in the summer, but when frozen in winter can be crossed easily. As a rule they are frozen firmly from October to May.

Extensive areas of the Kola Coast Tundra are covered by moors and marshes. One of the largest continuous areas of marshes lies along the upper and middle Ponoy river. Another is found in the eastern portion of the subregion. More or less continuous areas of marsh lie along the middle course of the Varzina river, between the Iokan'ga and the Ponoy rivers, and east of the Voron'ya.

Elsewhere, smaller marshes and peat bogs are scattered over the lake-dotted plateau surface. All the peat bogs reported in the Kola Coast Tundra are small and shallow in comparison to those in other northern Soviet areas. Bogs range from 0.1 to 0.2 square miles in area and depths are about 5 feet. Outcrops of stone are located in the midst of some of the marshes.

All the marshy areas are obstacles to movement during the spring and summer season. Near Ozero Vuliyavr the immense, level marshes which border the Ponoy flood plain are covered with water up to 8 feet deep for a week or 10 days in the spring. In winter (December to April) the marshes are frozen solidly and can be crossed readily by men on skis or dog sleds. The frozen marshes may support light vehicles.

(c) Vegetation (PLAN 5).—The dominant form of natural vegetation found in the Kola Coast Tundra (A-1) consists of moss in the broad upland depressions, and lichen growths on the drier spots and rocky outcrops. These low tundra growths, however, are repeatedly interrupted along the streams or on damp but fairly well-drained places by narrow bands of dwarf birches and willows, seldom more than 10 feet high. In the south and west the forest-tundra merges into dense forests (PLAN 2, B-1). Patches of meadow grasses and marsh vegetation also occur. Because of the severe climate, poor soils, and short growing season, agriculture is extremely difficult, if at all possible. The northern limit of agriculture roughly coincides with the southern boundary of subregion A-1 (PLAN 2).

Most of the Rybachiy - Sredniy peninsula is covered with mosses and other tundra vegetation, in many places reaching to the water's edge wherever the coast is not steep or rocky.

The coast of the Petsamo-ioki (Pechenga) area, which is exposed to north winds, is barren. A short distance inland, vegetation becomes comparatively varied for such high latitudes and consists of dwarf birches, berry bushes, and heather, all of which are less than 3 feet high. Southward along the fiords and gulfs the vegetation becomes richer and more profuse. Comparatively tall trees appear about 15 miles inland and gradually change from scattered dwarf birch to dense patches of conifers.

Tundra and forest overlap in numerous isolated patches, particularly between the Norwegian border and the Kola river. As a rule, the upland surfaces are covered with tundra vegetation, but lower elevations and those along the narrow stream valleys are clothed with stunted growths of pine, spruce, birch, and juniper.

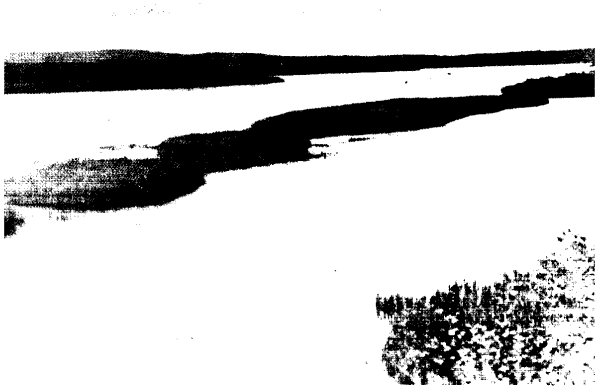

FIGURE II-10. *Aquatic sedge in the Voron'ya river.*
Alluvial islands, covered with aquatic sedge and other water-loving plants, are shown in the foreground. These growths are common along the rivers. 1887.

The Voron'ya river is bordered by sparse growths of spruce and birch and occasional pines. Birch growths reach the coast in most valleys. The flat upland summits along the middle course of the river are covered with tundra vegetation, chiefly lichens. Near Voron'ye on the Voron'ya, about 50 miles inland, flat patches are covered with dense growths of grasses about three feet high. Grasses include sedge, bluegrass, and reed grass (FIGURE II-10). The shallow margins of the Voron'ya are often choked with "water buttercup."

About 60 miles inland, just north of Ozero Lovozero (between subregions A-1 and B-1), peat-mound formations slope steeply toward the sphagnum moss quagmire bordering the lake. These mounds are covered chiefly by a dark sphagnum moss in places only 1.5 feet thick. Other growths include dwarf birch and berry bushes such as blueberry, cloudberry, crowberry, small cranberry, and mountain cranberry (lingenberry). The moist spaces between the mounds are covered with other species of sphagnum moss and cottongrass.

Various mosses, cinquefoil, and marsh marigold grow over marshes throughout the subregion. On seaward slopes there are small patches of peat bog heavily waterlogged in their upper layers and covered for the most part with sphagnum moss, willow, dwarf birch, crowberry, bog cranberry, and blueberry.

As a rule birch is not found on the broad, level upland areas less than 35 miles inland from the Barents coast. At its northernmost limit the birch appears as a bush, but only 5 miles farther south one encounters stunted birch trees about 10 to 12 feet high (FIGURE II-11). Such growths extend inland to the southern border of subregion A-1 (PLAN 5).

Vegetation of the Kola Coast Tundra is low and does not restrict cross-country movement. However, passage through the poorly drained sections would be extremely difficult except in winter when these areas are firmly frozen. Vegetation offers little or no concealment or cover.

(d) Trafficability of surface materials (PLANS 6 to 10).—Surface materials on the almost treeless, moss-covered Kola Coast Tundra in general consist of glacial deposits and glacial-scoured rock. Most of the coastal strip, 12 to 20 miles broad, is covered with clay or loamy material, with sandy loam in some places. In the interior sand and gravel predominate. The surface is composed largely of sand and stones and has little finer material. In numerous places soil cover is lacking completely, and the hard bedrock is exposed. The dome-shaped Vozvyshennost' Keyvy are strewed in places with granite stones and boulders. Continuous sand and gravel deposits are found only on the beach of Lumbovskiy Zaliv, the delta of the Iokan'ga river, and terraces of lake basins. Lowlands and flat areas usually contain peaty soils. Except in cores of peat mounds, such as those around the north end of Ozero Lovozero, reports indicate that permafrost (permanently frozen subsoil) does not occur on the Kola Peninsula. Soils above the permafrost are usually saturated during the summer.

Throughout the area cross-country movement is stopped for about eight weeks in May and June, during the period of spring thaws. Even well-built roads and railways are temporarily blocked by sinks and slides during this period. Melting ice and summer rains create muddy conditions and poor trafficability, particularly on deep soils in the narrow valleys and on the lower slopes of hills. Some areas with only thin soil layers over bedrock are dry and firm after June. In winter, (October to May) trafficability is generally good except during extremely cold weather.

(3) Subregion A-2, Trans-White Sea Tundra

(a) Relief (PLANS 2 and 3).—The Trans-White Sea Tundra (A-2) is essentially a slightly elevated, level-to-rolling plain. The area, which is divided into two unequal parts by the broad flood plain of the lower Pechora, includes the Malozemel'skaya (Little Land) Tundra west of the Pechora and the Bol'shezemel'skaya (Big Land) Tundra to the east.

FIGURE II-11. *Typical forest-tundra.*
This area at the eastern end of the Vozvyshennost' Keyvy in the upper Acheriok river basin is representative of all forest-tundra regions. Most vegetation consists of mosses, stunted, scattered birch, and low evergreens. Before 1900.

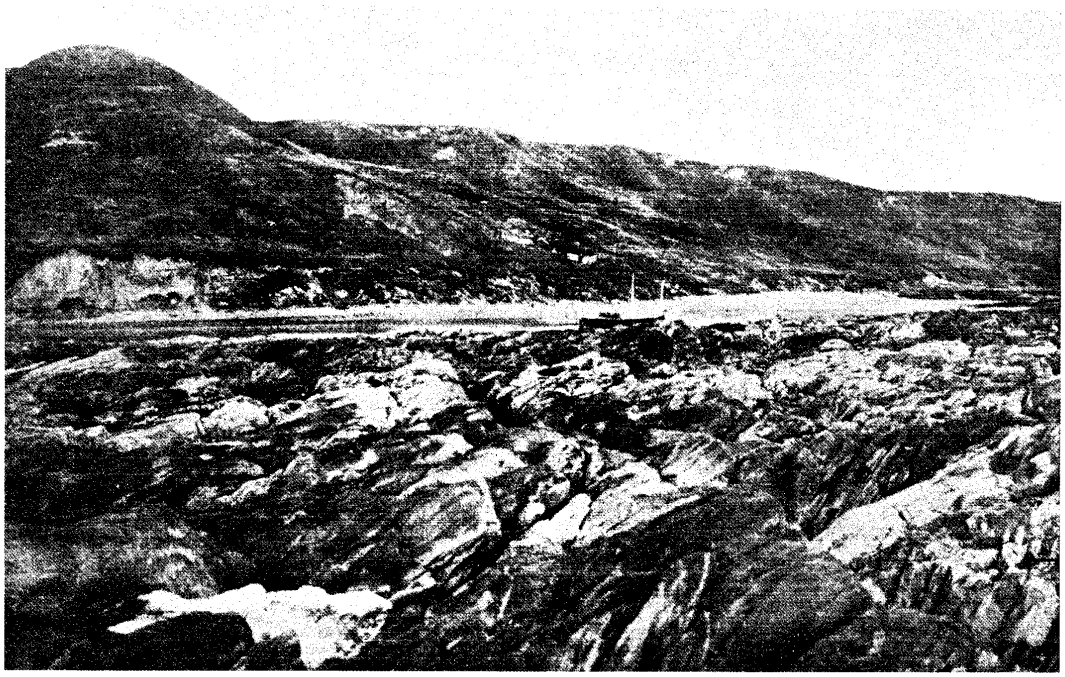

FIGURE II-12. *Northwest coast of the Poluostrov Kanin (Kanin Peninsula).*
The rocks in the foreground are exposed during low tide. The bluff in left center is typical of the northwest coast of Poluostrov Kanin. Steep slopes beyond the cove are covered with lichens and dwarf birches which furnish fodder for reindeer herds. Before 1941.

Most of the subregion lies north of the Arctic Circle and ranges from low, level, and marshy areas to gently sloping coastal sections; bedrock, coastal cliffs ranging from 130 to 160 feet in the extreme northwest of the Poluostrov Kanin (Kanin Peninsula) decrease to 15 to 30 feet toward the east (FIGURE II-12). However, the north coast of Chëshskaya Guba ranges from 30 to 60 feet high. Other coasts of this bay are rather uniformly low. The Yugorskiy Poluostrov (peninsula) coasts are also high and cliffed. In places steep clay, sand, and gravel cliffs line the coast (FIGURE II-13).

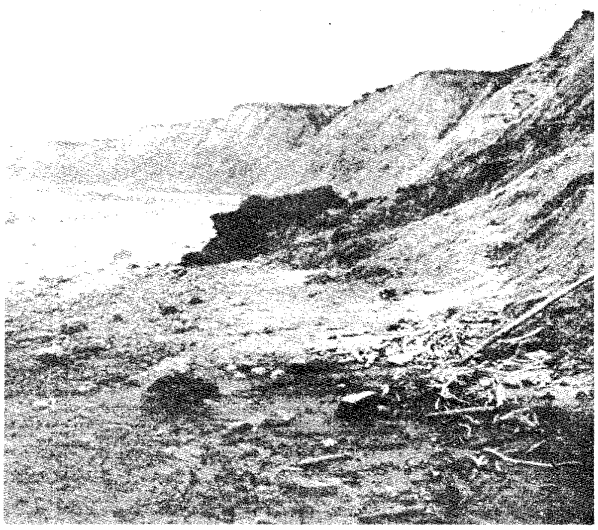

FIGURE II-13. *Coast near Mys Voronov.*
Steep, crumbling, clayey sand banks containing many rocks are cut by numerous gullies. A narrow beach, littered with much driftwood and rock, is exposed at low tide. Before 1941.

The narrow portion of subregion A-2 bordering the coast of the White Sea and eastward to the mouth of the Mezen' has a sandy coast with hillocks about 40 feet high covered with peat and small bushes. There are some marshy flats. This coastal strip is backed by level-to-rolling terrain. Detailed coastal descriptions are discussed in Chapter IV, 41, A, and B.

Extending northwest - southeast across northern Poluostrov Kanin (Kanin Peninsula) is the flat-topped Kryazh Kanin Kamen', in general 400 to 600 feet high, with a maximum elevation of 790 feet (FIGURE II-14). The ridge decreases southeastward and merges with the slightly dissected, terraced coastal plain, 150 feet in elevation and about a mile wide. A tundra plain, hillier in the northern portion, lies south of the ridge and extends as far as the base of the peninsula. This plain rises evenly to about 50 feet within 6 miles of the coasts. It is little dissected, and contains numerous small lakes and low moss-covered peat mounds. This type of tundra is covered with north - south oriented mounds, or bulges, about 9 inches high, 32 inches long, and 24 inches wide. They are carpeted with a layer of moss less than an inch thick, under which peat lies to depths of 9 to 10 inches. This type of tundra is difficult to cross.

Southward from the Chësha river and Chëshskaya Guba the elevation of the low plain increases and the terrain is slightly undulating. This area abounds in lakes containing sedge- and moss-covered islands. These lakes, of varied sizes and shapes, are surrounded by sedge marshes (FIGURE II-15).

Eastward, between the Pesha and Pechora rivers, the Timan Hills, in reality a series of five low, parallel, flat-topped ridges, from 600 to 1,060 feet high trend northwest - southeast across the subregion (PLAN 2, A-2a). The ridges have gently sloping sides and as they alternate with level tundra lowlands they give a distinct hilly appearance to the landscape (FIGURE II-16). In addition,

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FIGURE II-14. *Coast near Tarkhanovo on the Poluostrov Kanin (Kanin peninsula).*
Looking southeast. View of the northwestern portion of the Kryazh Kanin Kamen' along the coast. Gentle-to-steep slopes lead to the flat-topped ridge summit. Low rock cliffs rise from the water along the small beach at the upper right. Lichens and dwarf bushes growing on the ridge slopes furnish pasture for large reindeer herds. Before 1941.

FIGURE II-15. *Tundra landscape northeast of Mezen'.*
The extensive plain northeast of Mezen' as far as Chëshskaya Guba is only slightly undulating. Level terrain generally favors movement, but here numerous small lakes and tundra moors tend to restrict movement to sandy hills or low peat ridges crossing the marshy sections. In winter this area is frozen and movement of men, and at least light vehicles, is entirely feasible. Before 1941.

occasional bedrock outcrops of crystallines, sandstone, or limestone rise as hills above the plateaulike surface of the ridges, particularly in the northern portion. The ridges serve as the watershed between tributaries of the Pechora and Mezen' systems. The valleys of these rivers provide easy portages across the Timan ridge chain. In places, however, the streams cut through the Timan ridges in deep gorgelike valleys.

Eastward from the Timan Hills to the Pechora, is the Malozemel'skaya Tundra, a rolling, elevated, sandy plain about 450 feet above sea level, containing numerous streams and lakes. The highest point is over 600 feet high and lies west of the delta of the Pechora river. This high point is the northern terminus of one of several north-south trending ridges of glacial clays, sands, stone, and boulders common to the Malozemel'skaya Tundra. The sandy portions of the Malozemel'skaya Tundra also contain minor relief features, such as isolated or continuous ridgelike dunes and wind-hollowed spots and basins (locally called *yarei*). These wind-hollowed spots are irregular in shape, and are steep sided. Their depths vary from eight inches to over three feet. In some places several hollows blend into one large basin covering 60 to 80 square miles.

Southward to the southern border of the region the glacial ridges become lower (seldom above 300 feet), discontinuous, and finally merge in the slightly undulating marshy plain of the lower Pechora.

Although the extensive Bol'shezemel'skaya Tundra, extending east of the lower Pechora river as far as the northern Urals, is in general a low coastal plain, it possesses a variety of minor types of terrain. There is a gradual increase in elevation eastward, the surface is covered with alternate marine and glacial deposits, and vast marshy expanses are dotted with sandy and clayey hills. That portion of the tundra between the lower Pechora and the longitude of Khaypudyrskaya Guba (bay) has been studied less than the area farther east, but Russian geographic literature indicates that the two parts are very similar.

FIGURE II-16. *The Timan Hills.*
Most of the Timan Hills in subregion A-2 form low ridges covered with forest-tundra. This view shows spruce interspersed with low birch and bushes. Areas between the ridges contain lakes or marshy areas. Cross-country movement would not be easy in such terrain. Before 1941.

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The area bordering the lower Pechora is a gently rolling plain composed of crystalline rock covered with glacial material and alluvial deposits. The basin of the Kolva-Vis river which lies north of the Usa - Pechora confluence is an execptionally sandy plain with numerous small lakes, marshes, and sand hills. In places these sand hills shift with the wind because of scant vegetation cover.

Along the Khoseda-Yu river, to the east, high, thick, glacial ridges with large boulders, trend northeast - southwest across sandy glacial or marine deposits. The lower Khoseda-Yu is bordered by broad sections of flood plain, consisting mainly of meadows overgrown with willow bushes.

The Adz'va river, a right tributary of the Usa, flows through a lake-dotted, marshy plain containing thick peat bogs. Along sandy and well-drained parts of the river banks there are wind-hollowed basins and mounds of shifting sands.

The area north of the Adz'va river and west of the Korotaikha river is a vast sandy, slightly rolling plain containing large marshes and peat bogs. Here and there are deep lakes and broad, low glacial ridges that rise 60 to 80 feet above the surrounding land. This higher land forms the watershed between the Usa - Pechora tributaries and those streams flowing northward directly to the Arctic. The marshes and bogs are overgrown with dense willow growths from 7 to 13 feet high, which would hinder movement because they prevent free movement even of reindeer trains.

Eastward from the Korotaikha river lies the Khrebet Pay-Khoy, a low, old, worn mountain range, consisting of narrow, northwest - southeast trending, stony ridges. Isolated bedrock crests rise from its central part. Elsewhere the surface is covered by glacial materials. Some ridges rise 600 to 1,300 feet above sea level and 300 to 500 feet above the surrounding country. Elevation increases from northwest to southeast, but Gora Mor-Pay, only about 40 miles inland from Proliv Yugorskiy Shar, is 1,560 feet high and is the highest point in the Khrebet Pay-Khoy.

Usually the Pay-Khoy ridges are discontinuous. One extends almost unbroken from the Bol'shaya O-Yu river to the sources of the Kara. The surface between the ridges is covered by diverse glacial debris and immense sedge marshes; the terrain is slightly rolling, and slopes to the west and south of the Khrebet Pay-Khoy, becoming flat, and poorly drained. Near the coast low hills and short, low ridges rise above the plain. The surface is little dissected but contains short, narrow gullies, 160 to 330 feet deep, which open into the main river valleys. Generally the northeast - facing slopes of the Pay-Khoy are steeper than those facing southwest, and larger streams crossing the ridges form deep canyonlike valleys.

Eastward of the Pay-Khoy, elevation decreases gradually but the region is slightly hilly and contains numerous moraine ridges and marshes. Southeastward, the Pay-Khoy range is separated by a tundra plain from the most northern extension of the Urals. For detailed description of the northern Urals, see subregion B-2.

In addition to the mainland Tundra Belt Region, two large islands, Kolguyev and Vaygach are, included within the area of this JANIS. Ostrov Kolguyev lies about 60 miles northeast of Kanin peninsula. From the sea, the island has the appearance of a rounded tableland. In the middle of the island there are high hills, but no outstanding peaks. The northern and northwestern coasts are the highest, with bluffs standing 80 to 130 feet above the sea. These coasts are little indented. Most of the southern half of the island is rimmed by a low, sandy, coastal plain. Inland the plain gradually merges with the tableland of the interior. The island has numerous short rivers; their mouths are generally shallow and become blocked with sand and gravel when winds blow from the sea. Tundra vegetation covers the island.

Vaygach island is separated from the mainland by Proliv Yugorskiy Shar. It is a rocky island with many bays; many islets and submerged rocks surround it, being particularly numerous along the western and northwestern coasts. Ridges of limestone and shale, about 60 feet high, extend parallel with the western coast about 5 miles inland. About 7 miles from the eastern coast, a chain of northwest - southeast trending shale hills, (Sanina mountains) crosses the island. Viewed from the sea, the island appears to have a fairly even surface but, for the most part, the coast is steep and rocky.

(b) Drainage (PLAN 4).—Subregion A-2 is drained by hundreds of streams, but little is known about them since surveys for much of the area are not available. Therefore, most stream courses marked on maps are only in approximate location. The rivers and their main tributaries rise in marshy ground, flow northward or southward, and are serious obstacles to operations involving east - west movement. Some rivers are comparatively navigable in summer, but the numerous sand islands, shallows, and sandbanks require local pilots for safe navigation. The rivers of this subregion are fed principally by melting snow. Melt water in spring provides 50% to 70% of the yearly run-off; because the surface is still frozen melt water runs off rapidly. In winter, the frozen streams are by far the best transportation routes. Some coastal sections, such as that of Chëshskaya Guba, are crossed by a large number of streams which, during low tide, are very narrow and reveal a bottom of silt.

The two largest rivers crossing the subregion are the Mezen' and the Pechora. Since both rivers flow mainly through the forested subregion B-2 and their flood plains are covered with tree or meadow growths, they will be discussed under subregion B-2. However, that part of the Mezen' within subregion A-2 is 4.7 to 7.2 miles wide, is 22 feet deep at its mouth, and has a sandy bottom. Its rate of flow is one to two feet per second. The stream is ice covered from mid-November to early May. The Pechora has a wide, sandy, island-filled channel and flows through low, flat terrain. The river is about 27 miles wide in the delta region and has mouths 7.2 miles apart. Usually the Pechora is 8 feet deep at the mouth but depth may increase to 24 feet during prolonged north winds. Rate of flow varies from 1.5 to 2.5 feet per second. The stream is ice covered from the end of October to the end of May. Spring floods are common.

The Korotaikha is about 250 miles long and navigable by river boat for 50 to 100 miles at any water level. Even at relatively low water this river is an obstacle to movement, and reindeer herders must ferry across it. The Bol'shaya O-Yu is a swift river, averaging 130 to 160 feet in width. It contains many rapids and a deep narrow valley. Two terraces, 3 and 10 feet above the level of the stream, border the river. Boat travel at average water level is possible only for 40 to 50 miles upstream.

On the areas between the numerous rivers there is a multitude of lakes with interconnecting channels; some are temporary and are very shallow. Those lakes are serious obstacles to movement in summer. Many of the lakes, through natural drainage, have been replaced in whole or part by marshes, and some have dried up completely. The lakes of the Neruta lowland in the Malozemel'skaya Tundra lie in shallow, saucerlike depressions 1.5 to 7 feet

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deep with an average area of 2 to 4 square miles. Most of their shores and bottoms are peat covered.

Another lake-dotted area lies south and west of the upper Korotaikha river. These lakes are generally about 1 to 4 square miles in area, but those in the upper course of the Adz'va attain considerable size, being 10 or more miles in length.

There is much marshy area in subregion A-2. Extensive, poorly drained areas cover nearly 50% of the surface of the level lowlands and also are well developed on the flat tops of the glacial ridges. Peat mounds of various shapes, 15 to 40 inches high and flat topped, are separated by peat moss mires and cover about 35% of the entire tundra area. In places low, continuous peat ridges form natural passageways across the extensive marshes (FIGURE II-17). In the Bol'shezemel'skaya Tundra peat seldom exceeds 8 feet in depth, but in the west it does reach 13 or more feet. However, the mounds are not as high here, and summer thaw reaches greater depths.

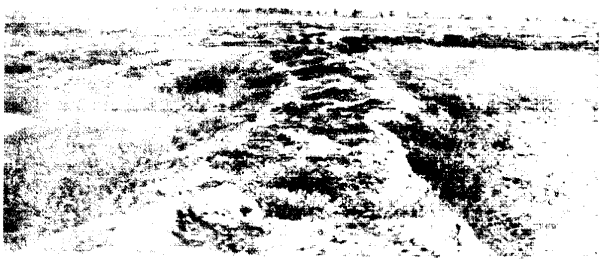

FIGURE II-17. *A peat ridge near the village of Nes'.*
Peat ridges provide in many places the only passageways across the low, marshy areas common to the Trans-White Sea Tundra. Marshy areas or stagnant pools are found on both sides of these natural causeways. Before 1941.

Along parts of the coast are extensive meadows. For example, one which is four miles broad and eight miles long lies at the mouth of the Vizhas. Another meadow five miles broad extends some distance upstream from the mouth of the Chësha. Throughout the entire tundra belt the scattered, extensive marshy areas prevent movement in summer, or restrict it to the better drained glacial areas which cross them. In winter these extensive marshes are frozen to various depths and are trafficable to a limited extent.

(c) Vegetation (PLAN 5).—The vegetation of the Trans - White Sea Tundra has been studied in detail only in the eastern part, but indications are that plant distribution is similar throughout the entire subregion. From south to north there are such varied types of tundra as 1) forest, 2) dwarf birch, 3) moss, and 4) in scattered areas, moss associated with willows or sedges. Lines of demarcation between the tundra types are not sharp and in many places overlap one another.

The forest-tundra forms a zone of transition from the dense forest on the south to the tundra on the north. The forest-tundra contains chiefly thin-trunked larches, pine trees, isolated clumps of dwarf birch, and areas of tundra. Typical sections of forest-tundra are found 1) in the basin of the Khoseda-Yu river from its headwaters to Khoseda Khard Cultural Base where patches of sparse spruce woods alternate with dwarf birch growths, alder, and other plant combinations; 2) along the right bank of the middle Adz'va, where dwarf birches dominate on better-drained sections and isolated spruces mingle with willows in its southern part; 3) in the basin of the Kolva-Vis.

FIGURE II-18. *High peat mounds in the Pechora basin.*
In parts of the Pechora Basin, peat mounds are serious obstacles to cross-country movement. Before 1941.

where sparse spruce woods occur; and 4) along the upper Usa and lower courses of its northern tributaries, the Bol'shaya Rogovaya and Adz'va.

In general the trees of the forest-tundra are confined to sandy soils, are not higher than 25 to 35 feet, and are widely spaced. On the northern edge of the forest-tundra, spruces, usually 3 to 7 feet high, occupy southern slopes. Higher-trunked stands of spruces are found in the river valleys but, wherever the surface tends to be saturated or water-logged, tree growths disappear.

On swampy portions of the forest-tundra, willow groves 7 to 13 feet high obstruct cross-country movement. In addition, there are impassable, tall sedge tussocks up to 3 or 4 feet high with deep mires between them, and bogs with flat-topped mounds occupy about one-third of the area. These mounds consist of peat, and generally are only 15 to 25 inches high. In some places, however, they are 10 to 15 feet high and form serious obstacles to cross-country movement (FIGURE II-18). The mounds are of varied shapes and sizes, averaging between 30 and 45 feet across; they are separated by depressions containing tundra grasses and peat moss.

Dwarf-birch tundra is found in damp but well-drained areas; in general, this type of tundra is passable but not trafficable. The dwarf-birch tundra is typified by numerous stands of low birches, only four to six feet high and varied forms of grasses and bushes. This type of tundra is the most extensive of all tundra subdivisions. The southern limit of the dwarf-birch zone crosses the Poluostrov Kanin (Kanin Peninsula) south of the Kryazh Kanin Kamen' (ridge), crosses the Pechora basin at about 68° N, includes the upper course of the Laya river and extends to the sources of the Usa. Typical sections of the dwarf-birch tundra include: 1) the watershed between the Adz'va river and Khaypudyrskaya Guba, 2) the lake region east of the headwaters of the Adz'va, and 3) the area between the lake region and the Korotaikha river. Included also are numerous peat marshes and patches of tussock. Isolated trees are found in well-sheltered places. The dwarf-birch tundra is almost completely lacking in forest growth.

One common plant association in the dwarf-birch tundra includes the marsh tea, an herb found under dwarf-birch growths. Its prevalence increases eastward and in places is more prominent than the dwarf-birch itself. The presence of marsh tea indicates great extremes of heat and cold. Lichens also grow in the drier portions of the dwarf-birch tundra. Willows 7 to 13 feet high also grow within the dwarf-birch tundra as a rule, but are confined to the hollows, small stream valleys, and the banks of brooks. These growths present major obstacles to movement, even to reindeer trains. Along well-established reindeer routes used by the local inhabitants, a broad, more

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or less unbroken band of dwarf-birch and or willow has developed naturally.

Northward from the dwarf-birch tundra a narrow zone of moss and moss-willow tundra borders the coast. Pure moss tundra prevails in the western and northern portions. Southeastward from Khaypudyrskaya Guba along the east - west middle course of Korotaikha river and eastward to the middle Kara, moss-willow tundra dominates.

Mossy tundra has sparse lichen growths, but neither trees nor underbrush. In general, moss tundra predominates on well-drained areas, whereas plant associations of sparse low bushes, mainly willow, but some birch, alternate with sedge growths on the moderately drained areas. On the rocky areas lichens are associated with low berry bushes. The birches are usually low, 5 to 8 inches high, flattened, and appear in small clusters; small, scattered willow bushes, 20 to 24 inches high, grow on damp, gentle slopes. Their branches are well developed and have a dense foliage. Strips of taller willows grow along the river valleys. Spaces between the bushes are covered mainly by moss, but sedge and reed grasses do appear.

In general, the moss tundra is much marshier than the dwarf-birch tundra to the south and contains much sedge, 15 to 25 inches high. Low bushes are not characteristic of this type of tundra but do grow in protected valley lowlands which are snow filled in winter.

Along the coast of Yugorskiy Shar strait is a tundra and sedge-marsh zone of "polygonal tundras" on dry swells, so named because the surface has been broken into a network of polygons by frost cracks. The greater part of the polygonal tundras is bare of vegetation and in many places is covered by fine rubble. In the deep cracks between the bare spots, mosses, lichens, and herbaceous growths appear.

Coastal meadows also occupy large sections such as the area 4 miles broad and 8 miles long around the mouth of the Vizhas river and the one 5 miles broad and extending inland from the mouth of the Chësha. Grasses are usually 16 to 18 inches tall and not very thick.

Vegetation develops and grows rapidly in the strong sunlight that prevails at the end of the snow-melting period. Two weeks after the disappearance of the snow the tundra blooms and becomes green. The color of this vegetation is chiefly green and remains so until late August. In the mossy or lichen tundra are patches of very light green and almost white reindeer lichens, which are visible for a long distance. In September and at the beginning of October the forest-tundra is dark green mixed with yellow; the dwarf-birch tundra is yellow, green, and reddish brown; and the mossy tundra is gray-green, with flecks of white and rusty brown. In summer in the zones of dwarf-birch and forest-tundra, fair concealment is afforded. During winter the bare bushes and clumps of trees no longer offer any sort of concealment.

(d) *Trafficability of surface materials* (PLANS 6 to 10).—Trafficability of surface materials of the Trans-White Sea Tundra (A-2) is similar to that of the Kola Coast Tundra (A-1). In general this subregion is covered with mixed glacial deposits consisting of clays, sands, stones, and boulders. This veneer of glacial material is generally thin or may be entirely lacking on some of the highest elevations of the subregion such as certain summits of the Pay-Khoy ridges on the Yugorskiy peninsula. Glacial deposits of the Malozemel'skaya and Bol'shezemel'skaya Tundras, however, average 13 to 16 feet deep but may be as deep as 130 feet and contain a large number of boulders. Bedrock outcrops are conspicuous in the northern portion of the Timan Hills.

Except for the rock outcrops in the Timan Hills and elevated parts of the Malozemel'skaya and Bol'shezemel'skaya Tundras, much of the surface is covered by extensive marshes, bogs, and swamps. In places, the extensive peat bogs are crossed by long, elevated peat ridges or mounds which are fairly dry in summer and used locally by the inhabitants as routes across the bogs.

A clay belt borders the Khoseda-Yu river, but about 60 or 75 feet above the valley floor clay is replaced by level sandy terraces on both sides of the river. These terraces are overlain by a heavy, bouldery loam.

In contrast to subregion A-1, the greater part of subregion A-2 has a permanently frozen subsoil layer (permafrost) 12 to 80 inches below the surface. This frozen layer varies in thickness from 70 feet in the lower Pechora valley to 1,600 feet on Vaygach island northwest of Yugorskiy peninsula. Permafrost is absent on the Poluostrov Kanin (Kanin peninsula) and in coastal areas. Land underlain by permafrost usually is marshy, for the impermeable layer of frozen subsoil prevents proper underground drainage and thus permanently waterlogs the top layer of soil. This phenomenon occurs even on fairly steep slopes, where irregularities in the depth of the frozen layer may act as dams to the underground water.

Depth of thaw is never great. It is shallowest beneath a peat cover and deepest in well-drained, sandy soils. The Russians have reported depths of thaw in the Bol'shezemel'skaya Tundra peat beds to reach 1.6 to 2.6 feet; in loamy soils, 2.3 to 4 feet; and in sandy soils, 5 to 6.6 feet. These figures, however, refer only to areas not subject to the action of lake or running water and those not under snow cover. Soil is not frozen under snow drifts 10 feet deep unless freezing occurred before the period of continued snow.

In general there are great difficulties to movement of men and vehicles at all seasons in the Trans-White Sea Tundra subregion. Surface materials are nontrafficable during May and June and during alternate periods of thawing and freezing when mud is deep. Another short, nontrafficable or mud period occurs in October before the onset of continued frosts. This mud period is caused by frequent rain or snowfalls and alternate periods of freezing and thawing. Mud is most notable on clay-filled, river-valley bottoms. Surface materials are most trafficable during the winter when the moors and marshes may be frozen firmly enough to support vehicles. However, cold weather and deep snow drifts in places hinder all forms of cross-country movement. During the summer, cross-country movement is impracticable for men, vehicles, or animals because the heat in the short summer months is not sufficient to dry out the surface in the extensive, low, undrained depressions. Peat bogs and marshes generally remain impassable even in the late summer and autumn. Sandy soils and rocky areas dry out quickly and are usable for limited movement, but such areas are not continuous. In general, there are great difficulties to movement of men and vehicles at all seasons in this subregion.

B. Region B, Northern Forest Belt

(1) Introduction

Stretching across the northern part of the USSR from Finland to Asia, south of the Tundra Belt (Region A), is the Northern Forest Belt (Region B). It includes the northern part of the great Russian plains of Europe, the northern section of the Ural Mountains, the mountains

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of the Kola Peninsula, and some other, lesser uplands. The soils of the Region are mostly of coarse materials left by the old continental glaciers, with much clay, sand, gravel, and boulders. Typical vegetation of the plains, and spreading up the hills and mountains, is the coniferous forest with a slight admixture of broadleaf trees. Breaks in the forest cover include poorly drained meadows and marshes and some cultivated fields. Very little area, however, has been cleared for cultivation and the population of the entire region is scant. Both population and cultivated area are mainly in the southwestern part of the Region.

The Northern Forest Belt is accessible by sea from the west and the north (Baltic and Arctic) and by land from the north, west, south and east. Most land routes to the area cross many swamps and marshes, gravel ridges, rock hills, dense forests, and many lake-covered areas.

In general the region of the Northern Forest Belt is rectangular in shape, having an east - west length of about 850 miles and a north - south breadth of about 500 miles. Irregularities to this shape, however, are at the northwestern and southeastern corners. At the former, is a bulge which includes about 50,000 square miles; at the latter, a somewhat smaller area is missing from the rectangle. The approximate total size of the Region is 450,000 square miles. This is about the area of Texas, Oklahoma, and New Mexico combined.

The area suitable for maneuver is limited by forests and marshes even in the plains and lowlands. Throughout the hills and mountains the irregular terrain and the forests combine to make movement difficult.

The greater part of Region B consists of wide plains with minor interruptions of low hills and swells between the many streams. The major uplands are for the most part near the borders of the region—the mountains of the Kola Peninsula in the northwest, the ranges of hills along much of the Finnish border, the northern Ural Mountains on the east, and the gently rising swell on the south which forms the Volga-Arctic divide. Other uplands are the ranges of hills east of Lake Onega and the Timan Hills which lie across the northeastern section of the Region.

Except for a relatively small section in the southwest, the entire Region drains to the Arctic Ocean and its arms. Since the White Sea (Beloye More) cuts deeply and irregularly into the northern coast, short streams flow into it from north and west, as well as from the south. The two largest rivers in the Region are the Northern (Severnaya) Dvina and the Pechora. The former flows northwest into the White Sea; the latter, generally northward into the Pechorskaya Guba (bay). There are many lakes and much poorly drained land—both swamps and marshes—within the Region, particularly in the western half. The greater part of the southwestern section, including the two large lakes—Ladoga and Onega—drains to the Gulf of Finland, and the extreme southern part drains south to the Volga.

In general the surface materials of the region consist of a thin, irregular, glacier-deposited cover of clay, sand, gravel, and boulders. Many boulders are of such size as to interfere seriously with troop and vehicular movement. Patches of muck are found here and there and the soils, which have a large admixture of clay, are very sticky when wet. Marshes and swamps are difficult to cross mainly because of lack of drainage and, in the latter, the stand of trees. Over the whole region, however, the soils and surface waters are frozen firmly during the winter months and thus are readily trafficable.

The predominating vegetative cover is the coniferous forest. This is mixed in some places—to a greater extent in the south—with deciduous trees which are mainly linden, birch, aspen, and willow. Spruce forests cover great areas in the south and central sections; the stands are generally thick and the undergrowth relatively unimportant. In the north, pines predominate; here the forests are more open and the undergrowth of shrubs and berry bushes is relatively greater than in the spruce forests; tree trunks, moreover, are shorter in the north. Along many streams throughout the forests there are dense bands of willow and birch thickets. These are found especially where streams cross occasional breaks in the forests, such as meadows and marshes. Grasses predominate in the meadows, and in the marshes, reeds and shrubs are numerous. Other breaks in the forests have been made by clearings devoted to crops, but such area is very small.

The Northern Forest Belt is divided into two subregions: the Kola-Karelia Hills and Lowlands (B-1) and the Northern Dvina-Pechora Basins and Hills (B-2). Each of these will be discussed separately.

(2) Subregion B-1, Kola-Karelia Hills and Lowlands (PLAN 3)

Subregion B-1 and Region A-1 occupy the extreme northwest corner of the Soviet Union, adjacent to Finland. The boundary with Finland is about 950 miles long. Subregion B-1 has a maximum north - south length of about 800 miles and an average east - west width of about 250 miles across its central part.

The relief, which nowhere reaches more than 4,000 feet above sea level, is distinguished by a gradual downward slope from the Finnish border toward the east, and by distinct terrain features trending northwest - southeast. Much of the area is made up of features such as elongated ridges, tumbled piles of clay, sand, gravel, and boulders, and lakes, and poorly drained plains. Hill sections alternate with a multitude of lowlands occupied by lakes, rivers, and swamps.

The relief of the subregion falls into three major types: low mountains, hills, and coast or lowland. This subregion is divided into six sections (PLANS 2 and 3, FIGURE II - 33). These will be discussed separately.

(a) Relief (PLANS 2 and 3).—The Kola-Karelia Low Mountains (FIGURE II-33, B-1a) area is the most elevated, mountainous, and complex part of the subregion. There are five east - west trending series of elevations, ranging from low hills to plateaus and low mountains (called "mountain tundras"), with heights varying between 1,000 and nearly 4,000 feet above sea level. These swells are separated by predominantly swampy, lake-filled depressions which also trend east - west. These depressions provide difficult but feasible strategic avenues of approach from Norway and Finland to the economic heart of the Kola Peninsula, the Imandra-Kandalaksha area, and Kandalakshskaya Guba, despite the general ruggedness of this part of the peninsula. One major and several minor depressions, leading from the ice-free northern coast, provide strategic avenues of approach to the east - west valleys and to the southern coast of the Kola Peninsula.

All of the depressions are similar; all consist of forested and swampy plains, 150 to 650 feet above sea level, in places slightly hilly, or with a few isolated hills and ridges rising from 750 to 850 feet above the swamps. The hills and ridges serve as natural obstacles to cross-country movement and as natural defense sites.

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The four major strategic depressions are, from north to south:

1) The Notozero-Lovozero depression follows the Lota river, Ozero Notozero, Tuloma river, Ozero Kolozero, the lowland along the north foot of the Khibinskaya Tundra and Lovozerskiye Tundry, Ozero Lovozero, and the Ponoy river to the east coast of the Kola Peninsula. The relatively broad lowland is much reduced in width between the Tuloma and the Kola rivers by the high and steepsided mountain spurs and hills of the "mountain tundras" to the north and south.
2) The Babinskaya-Imandra depression follows Ozero Girvas. Ozero Babinskaya Imandra, the lowland along the south foot of the Khibinskaya Tundra and the Lovozerskiye Tundry. Here this depression joins the northernmost one to include routes along Ozero Lovozero, and the Ponoy river to the east coast of the Kola Peninsula.
3) The Kovdozero depression which follows Ozero Kovdozero, Ozero Tolvant, and crosses a mountain divide to Kuolayarvi (formerly Salla). The railroad connecting Kuolayarvi, near the Finnish border, with the Kirov (Murman) railroad follows this depression.
4) The Olanga-Pyaozero depression, which follows the Olanga river and Ozero Pyaozero.

In addition to these major east - west trending depressions, there are several shorter and narrower east - west depressions of secondary importance. Numerous north - south transverse valleys of various sizes, some of which are broad, such as that of Ozero Umbozero, connect the major east - west depressions.

The major north - south depression, formed by the Kola river, Ozero Kolozero, Ozero Imandra, Niva river, connects the ice-free northern coast of the Kola Peninsula at Murmansk with the southern coast at Kandalaksha. This route is followed by the Kirov (Murman) railroad running south from Murmansk (FIGURE II-19).

FIGURE II-19. *The Niva river valley, 3 miles north of the town of Kandalaksha.*
Looking north. The Niva river valley, covered with coniferous forest, forms part of the north - south depression connecting the ice-free port of Murmansk and Kandalaksha. Mount Zheleznaya Gora ("Iron Mountain") is in the right background. Before 1941.

A secondary north - south depression follows the Voron'ya river, Ozero Lovozero (lake), and the Varzuga river to the southern coast of the Kola Peninsula. A variation of the route following this depression turns west at the southern end of Ozero Lovozero, skirts the south foot of the Lovozerskiye Tundry and Khibinskaya Tundra, and continues along either Ozero Kanozero or Ozero Imandra and the Niva river to Kandalakshskaya Guba. A northeast - southwest trending depression follows the Kola, Tuloma, and Lota river valleys. In the extreme southwestern section, the lowland connects with the east - west trending Babinskaya Imandra lowland.

The low mountains of the subregion, called "mountain tundras" by the Russians, include parallel chains of both small and large detached mountains and ridges trending northwest - southeast or west - east. In some places the

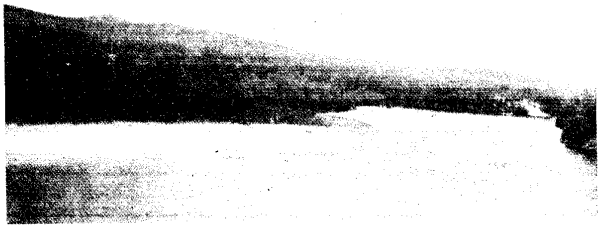

FIGURE II-20. *Valley of the Lota river.*
Looking north-northwest. The mountain in the left background, elevation about 1,560 feet above sea level, has a smooth, rounded summit typical of the mountains in the Kola Peninsula. The banks of the river are sandy. The river can be crossed easily in the section shown here, but there are large rapids farther downstream. Before 1941.

chains of ridges combine to form plateaus. These are bordered by numerous radiating spurs and by lowlands (FIGURE II-20).

The highest mountains, with peaks almost 4,000 feet above sea level, stretch eastward between the Notozero-Lovozero lowland and the Babinskaya Imandra lowland. Northward and southward, the mountains are lower; the highest peaks in the north reach almost 2,000 feet and the highest in the south reach more than 2,500 feet at a point north of Kandalakshskaya Guba. In the extreme south, a peak reaches nearly 2,000 feet.

The rocky summits of the mountain tundras are generally broad, smooth, and rounded (FIGURE II-21). Some are covered with sharp-cornered boulders and morainal debris. In places there are high, vertical-walled, semicircular recesses (cirques). Some of the dome-shaped summits are separated by broad, flat gulches, into some of which rather deep valleys are cut.

FIGURE II-21. *A typical view of low mountains in the Kuolayarvi area.*
Probably looking north from the northern slope of the foothills. Gora Rokhmoyva (2,150 feet above sea level), 9 miles south-southwest of Kuolayarvi, is the highest summit in the Kuolayarvi area, ceded by Finland in 1945. The coniferous forest in the valley, the brush on the slopes between litters of loose rocks, and the rounded bare summit, are typical. Before 1941.

The mountains are separated by deep, narrow, and angular north - south and northwest - southeast trending gorges, ravines, valleys, and basinlike depressions having steep slopes, many of which are vertical. Many of these depressions are relatively broad (one to six miles) and are occupied by large swamps, lakes, streams, and forests. Noteworthy is the fact that the mountain slopes drop steeply to the major east - west trending lowlands.

The steep slopes are covered in places with large sharp-cornered blocks of stone and boulders. In many places the irregular, hummocky, hilly swells surrounding the

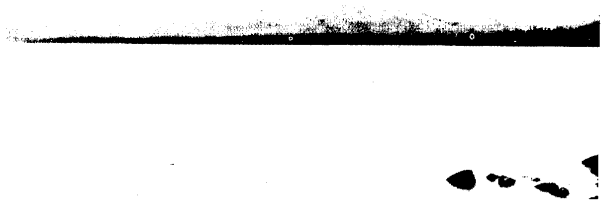

FIGURE II-22. *Khibinskaya Tundra (mountains).*
Looking eastward from Ekostrovskiy on the western shore of Ozero Imandra. The top of the mountain has a smooth and rounded, gently sloping, plateaulike outline. The sides drop steeply to the lowland along the Ozero Imandra. Irregular hummocky moraine hills encroach on the lower slope. A strip of coniferous forest shows along the east shore of Ozero Imandra and the lower mountain slopes. The upper slopes and tops of the mountain are bare. Before 1941.

mountains encroach on the lower slopes; on the slopes of some of the mountains, there are terracelike earth ledges.

Special mention must be made of the two largest mountain masses of the subregion. The Khibinskaya Tundra has a maximum elevation of 3,963 feet and is 20 to 24 miles across at the base (FIGURE II-22). The Lovozerskiye Tundry has a maximum elevation of 3,694 feet and is 10 to 20 miles across at the base. These mountains have many of the general features of the others in the area; but in addition to being larger and higher, their steep sides are cut with a great number of valleys and deep gorges. In many parts, almost vertical walls rise 1,500 to 2,000 feet above the surrounding lowlands. In contrast to other mountains of the subregion, their generally rounded summits are broken by sharp peaks, and precipitous walls rise several hundred feet above them. Both mountains are horseshoe-shaped; a deep, angular sink opens southward in the Khibinskaya Tundra (FIGURE II-23) and eastward in the Lovozerskiye Tundry.

FIGURE II-23. *Khibinskaya Tundra (mountains).*
Looking west. Ozero Bol'shoy Vud'yarn (Lake Yun (Big) Vudyavr) is located in a spacious, deep, angular sink in the southern part of the Khibinskaya Tundra. The southern shore of the lake, to the left in the photograph is now occupied by the apatite mining center, Kirovsk. The relief has been modified by heavy glaciation, which shows in the smooth and rounded outlines of the mountain's surface. The mountain slopes drop steeply to the depression. The lower slopes are forested, the upper slopes and summits are bare. 1891.

The steep-sloped mountains of subregion B-1 will stop all cross-country movement of vehicles; however, the relatively broad, flat, east - west and north - south trending depressions provide strategic avenues for movement of mechanized forces, despite the general ruggedness of the terrain. The most important route follows the north - south trending Kola river - Ozero Kolozero - Ozero Imandra - Niva river depression connecting the ice-free port of Murmansk with Kandalaksha. The best route from the west is through the Kovdozero depression connecting Kuolayarvi and Kandalakshskaya Guba. In the depressions, low, but in places steeply sloping, hills, rising above the general surface, will restrict and channelize movement and provide natural defense sites.

The Western Hills (FIGURE II-33, B-1b) area extends from the southern border of the Kola - Karelia Low Mountain area in the west to the Svir' river depression. The altitude of the area is between 300 and 700 feet in the east, and most of area rises westward to about 700 to 1,000 feet. In the southwestern part elevations decrease toward Lake Ladoga. The highest elevation, 1,296 feet above sea level, is near the center of the area between Ozero Segozero and Ozero L'yeksa. The surface in general is hilly and the higher, central part is fairly rugged and dissected; however, in the lower-lying areas near the northern and southern borders, the terrain is rolling, without prominent heights.

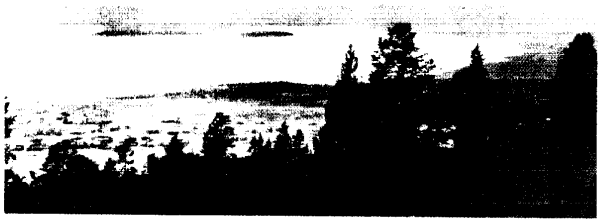

FIGURE II-24. *Yevgora village on the south coast of Ozero (lake) Segozero.*
Probably looking in a northerly direction. Yevgora village stands in a small cleared and cultivated area bordered by hilly, forested land. The elongated, northwest - southeast trending ridges of bedrock and glacial debris are typical of the Western Hills section of the subregion. Before 1941.

The northwest - southeast trend of the relief features is especially pronounced in this area (FIGURE II-24) and elongated, isolated groups of ridges and hills would affect movement. The numerous parallel northwest - southeast and north - south trending hills and ridges reach elevations of 300 to 800 feet above sea level and include irregular, hummocky hills, long narrow ridges, oval-shaped hills, and swells with an irregular serpentine course. The length of the ridges and swells varies from a few dozen yards to one or more miles, and heights range from only a few feet to 200 or 250 feet. Some of these ridges stand in groups of chains which are as much as 5 to 6 miles long. The interridge areas form a complete network of more or less swampy depressions of varying widths. A few comparatively level expanses are found. The river valleys follow the general trend of the relief, and long, narrow lake depressions characterize the area. Ridges formed primarily of bedrock outcroppings have steep slopes; in many sections they render the terrain difficult to traverse. Other ridges, covered with a mantle of glacial sand and stones, have gentle slopes.

The very irregular, northwest - southeast trending hilly relief will interfere with all cross-country movement across this grain and will tend to channelize all movement in a northwest - southeast direction. The area situated between Lake Ladoga and Lake Onega (often called South Karelia or the Olonets Isthmus) was the theater of most of the military action in the Soviet-Finnish wars of 1939-1940 and 1941-1943. This area is described below as the Ladoga-Onega Lowland (B-1f). Operations along the rest of the Soviet-Finnish border soon bogged down and re-

mained more or less stalemated by terrain and climate. This occurred despite strong efforts by the Finns and Germans to push eastward from the Kuolayarvi district and cut the Kirov (Murman) railroad at Kandalaksha, where it was then nearest to the border. Like the area described above, the Western Hills are better suited to defense than attack. The Finns, however, advanced across the Olonets isthmus to Lake Onega and occupied Petrozavodsk on the Leningrad-Murmansk railroad.

The Eastern Hills (FIGURE II-33, B-1c) area has been explored very little according to available Russian publications. The relief of the area consists largely of a chain of five low ridges roughly forming an open question mark around the eastern side of Lake Onega and extending southward. These include from south to north: the northern part of the Valdayskaya Vozvyshennost' (Valdai Ridge), which has a maximum altitude of 886 feet; the Tikhuinskaya Gryada (Tikhvin Ridge), 958 feet; the Megorskaya Gryada (Megra Ridge), south of Onezhskoye Ozero, 968 feet; the Andomskaya Vozvyshennost' (Andoma Heights), 850 feet; and the Vetrennyy Poyas, 823 feet. The general elevation is 300 to 600 feet above sea level, and the higher summits are about 600 feet above sea level and average 200 to 300 feet above the neighboring valleys. These ridges are separated by relatively broad, open, terraced valleys with gently rolling surfaces, which include some swampy sections. The valleys are oriented in a northwest - southeast direction, except for the northernmost one, that of the Vodla, which is oriented west - east. The ridges cross major routes from Leningrad to the east. The region north of the Vytegra Valley lies outside the areas of major traffic, since the routes to Arkhangel'sk, Murmansk, and other points on the White Sea completely avoid it.

On the one hand the ridges are either broad and flat-topped, or rounded, and are composed of bedrock covered with loose glacial materials of varying depth. On the other hand, there are long, serpentine and narrow ridges, or irregular, hummocky hills consisting wholly of loose glacial material. The slopes of the ridges and hills vary greatly and are gently rounded throughout the area. These slopes are said to be frequently cut by short, steep-sided valleys and gullies.

The five low ridges and the relatively uneven surface, especially the greatly dissected valley slopes and irregular, hummocky hills, would interfere with cross-country movement. However, the major east - west trending valleys separating the major ridges provide avenues for movement across the area.

The southern part of the Kola - White Sea Coast area (FIGURE II-33, B-1d)—a belt about 25 to 40 miles wide along the White Sea—is a swampy plain rising in broad steps from the coast inland, attaining an altitude of 300 to 500 feet above sea level. The step effect is particularly marked in the narrower eastern section of the belt; in the west the general relief is lower. The flatness of the steps is broken only by minor relief forms, but these are fairly numerous. Sand dunes line the coast in the vicinity of the Varzuga river and along other parts of the coast there are long, low, narrow ridges with an irregular, serpentine course and oval-shaped hills. About 13 to 15 miles inland an irregular chain of hummocky, moraine hills enclose many basins. Lakes are formed where these hills have dammed the rivers. Elsewhere on the steps are low, flat-topped ridges, widely separated by expanses of plain.

Northward from the steps is a plateau which, except for some valleys which cut it, occupies the rest of the area. The plateau, like the steps leading to it from the coast, is largely swampy. Its surface is characterized by outcrops of hard bedrock having, for the most part, smooth, rounded outlines. The plateau is crossed by long bedrock ridges trending northwest - southeast and rising about 400 feet above the general level of the plateau. These ridges increase in altitude toward the northwest, where they reach a maximum height of about 1,000 feet above sea level.

The valleys of the upper Varzuga and upper Ponoy rivers which cut the plateau have broad, relatively flat, and very swampy floors. Above these valleys, however, are many low, gently sloping hills and some ridges of bedrock. The ridges trend mostly north - south, and some are connected by lower hills. Some of these elevations rise 300 to 500 feet above the valley floor, but most of them are lower. Some of the ridge slopes rise almost vertically 150 to 400 feet. Basins of drained-off lakes constitute other minor irregularities on the valley floors.

Ridges and low hills obstruct movement in the relatively flat coastal area. Movement across the area is handicapped by the lack of railroads and by the few roads in the area, whose usefulness depends upon the weather and the time of the year.

A belt of swampy lowland, varying in width from 25 to 50 miles and skirting the southwestern shore of the White Sea, constitutes the greater part of the Southwest White Sea Coast area (FIGURE II-33, B-1e). Extending from the head of Onezhskaya Guba (Onega Bay) to Kandalakshskaya Guba, the generally flat plain rises gently inland in a number of steps to elevations between 300 and 500 feet above sea level. Here and there, mainly near the coast and particularly in the extreme north, low hills of hard bedrock rise above the broad, flat valleys of the many streams crossing the lowland. A few of these hills stand from 300 to 600 feet above the surrounding, swampy plain.

The landscape of the Onezhskiy Poluostrov (Onega Peninsula) contrasts strikingly with the flat lowland west of the Onega river. Running the length of the peninsula are two roughly parallel chains of irregular, hummocky hills. The larger chain, near the southwestern coast, is 4 to 9 miles broad and extends southward beyond this area to the Vetrennyy Poyas, hills inland from the head of Onezhskaya Guba (Onega Bay). Near its mouth the Onega River breaks through this chain of hills. The average elevation of these hills is about 380 feet above sea level, the maximum elevations being slightly over 500 feet. The Solovetskiye Ostrova (islands) are a continuation of this chain and have altitudes up to 450 feet above the sea. The other chain of hills lies along the northeastern side of the peninsula and elevations do not exceed 450 feet. These hills are separated from each other and from the chain of hills to the southwest by swampy, north - south and east - west valleys.

The relatively flat surface and low relief of the swampy plain extending west and northwest from the Onega river present no serious terrain restrictions to cross-country movement, except for some isolated hills in the north and the generally poor drainage. On the Onezhskiy Poluostrov (Onega Peninsula) the irregular, hummocky hills constitute some restrictions to cross-country movement and would channelize movement locally along the major valleys in areas where the swamps can be avoided. This district is an important transit area because it contains sections of the Kirov (Murman) railroad, part of the railroad which connects the Kirov line with the railroad between Arkhangel'sk and Moscow, and a section of the Stalin White Sea - Baltic Canal.

The Ladoga-Onega Lowland area (FIGURE II-33, B-1f) comprises four generally low sections surrounding Ozero

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Vygozero, Onezhskoye Ozero, Lake Onega, the Svir' river, and Ladozhskoye Ozero (Lake Ladoga). With the exception of its southwestern section, which adjoins the Forest and Clearings Belt (Region C) the area is bounded for the most part by the Western and Eastern Hills areas.

The Ozero Vygozero and Lake Onega depressions are a natural continuation of the White Sea coastal lowlands. They are parts of an area of great military importance, serving as a major north - south corridor, containing important sections of the Kirov (Murman) railroad and the Stalin White Sea - Baltic Canal. The Ozero Vygozero depression is connected with the coastal zone by the Vyg river valley. The depression has a low, rolling surface, in places hilly, rising toward the south, where it attains a maximum altitude of 500 feet above sea level along the watershed between Ozero Vygozero and Lake Onega.

The northwest - southeast trending, fingerlike peninsulas projecting into the northern end of Lake Onega have steep shores and surfaces which are partly low and partly rolling (FIGURE II-25). Around the southern half of the lake the land is relatively level, in contrast to the rolling surface to the north, and is terraced to some extent. Many streams have cut shallow valleys in this generally flat terrain.

The Svir' river and Lake Ladoga lowlands form a natural east - west corridor leading from the interior and from the Ozero Vygozero and Onezhskoye Ozero depressions to the Gulf of Finland at Leningrad. This continuous lowland area serves as a major east - west corridor, containing important sections of the White Sea - Baltic waterway and of the Kirov (Murman) railroad and other railroads, some of which connect with the railway net of southern Finland.

The relatively broad lowland of the Svir' river has a flat-to-rolling, terraced surface which rises northward and even more southward to 400 to 600 feet above sea level.

The Lake Ladoga lowland is bounded on the west, northwest, and north by ridges which rise to an altitude of 300 to 550 feet above sea level (FIGURE II-26). The ridges are dotted with small domes or knobs, some of whose sides are steep. This hilly section was the core of the defense of Leningrad against Finnish attacks from the Vyborg (Viipuri) area, then a part of Finland. Troop movement was impeded by the rolling, forested terrain.

FIGURE II-25. *North shore of Lake Onega.*
The north shore of Lake Onega is cut by long, narrow bays or fiordlike arms trending northwest - southeast. The terrain is hilly but nowhere very high. The amount of cultivated land is considerable for Karelia. Many fields, meadows, and roads are enclosed with man-high fences of closely spaced laths. Before 1941.

From the eastern shore of Lake Ladoga the terrain rises gradually (11 to 16 feet per mile) toward the Western Hills area. The surface of the higher sections near the hills is rough; some of the surface forms are in long narrow ridges with an irregular, serpentine, north - south course.

These ridges, in general parallel, would interfere with movement from the southwest or northeast and would tend to channelize movement in a northwest - southeast direction. The ridges would also provide good defense sites. Around the southern part of Lake Ladoga the relief of the lowland is as flat as that around the south end of Lake Onega.

FIGURE II-26. *Ryaysyalya (Räisälä) about 20 miles west Lake Ladoga.*
The low, rolling, in places hilly, forested surface, interrupted in many places by cultivated areas, is typical of the area west of Lake Ladoga. The Finnish town of Tyaysyalya (Räisälä) and the surrounding area have been in the Soviet Union since 1945. Before 1941.

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On the whole, the flat or rolling relief of the Ladoga-Onega Lowland area, with low hills in places, presents only local relief restrictions to cross-country movement.

(b) Drainage (PLAN 4 and FIGURE II-33).—The area is drained by a multitude of rivers, lakes, swamps, and moors of various sizes. No available map or set of maps shows more than a fraction of these innumerable features in the subregion, and the courses and outlines of many of those shown are admittedly inaccurate (July 1947). In many parts of the area there are no clearly defined watersheds, and the natives declare that most of the water systems are interconnected by swamps and bogs. This drainage condition is the most important factor in the military geography of the subregion. The problems associated with movement in a swampy, wet, forested area, interlaced with rivers and dotted with lakes, are present nearly everywhere. This kind of area is best traversed in winter, even despite relatively deep snows.

The rivers are relatively short and closely spaced; their width varies greatly, narrow stretches alternating with numerous lakelike reaches. Long stretches of the streams are broken up into numerous arms which flow around a profusion of islands at different velocities. Many of the rivers contain series of falls and rapids (FIGURE II-27). The rapids are particularly broad and many are so shallow in summer that they can be forded.

FIGURE II-27. *Rapids of the Segezha river near the river's exit from Ozero (lake) Segozero.*
(Lake) Segozero discharges northward into the Segezha river, a stream about 55 miles long and full of rapids. The river is reported to be ice covered from October to the end of April or beginning of May. Typical of the subregion are rapids and low, partly rocky, river banks covered with coniferous forests. Before 1941.

The annual fluctuations of the levels of many rivers are quite large, particularly those which do not have large lakes in their systems. The water level is lowest in late winter, just before the thaw, and there is a second low during the late summer. The melting of the snow cover in the spring regularly produces very high water; the melting is reported to begin about the first of May in the south and in May to June in the north, but the exact dates vary greatly from year to year. The rivers may rise 30 feet or more and become torrents which may prove to be impassable obstacles. It is not rare for rivers to change their courses, because during the high water in the spring they overflow wide areas .The summer and fall rains also often cause a noteworthy rise. The volume of streams draining through large lakes, however, is comparatively well balanced.

Rivers, in common with other bodies of water, are frozen over during the entire cold-weather period and cease to be obstacles then; rather, they become readily used highways. In the southern part of this subregion the rivers first freeze over sometime between mid-November and the beginning of December; in the central and northern parts they begin to freeze over early in November. It usually takes only a few days after the onset of the cold weather to form ice thick enough to support light vehicles. In general, the ice on the rivers is thick enough to support heavy vehicles as early as November or December and it continues to be capable of supporting vehicles until shortly before it breaks up in spring. The break-up is between the end of April and the end of May in the southern and central parts and between mid-May and the beginning of June in the northern part. It should be noted that the dates of freezing and thawing vary greatly from stream to stream.

The relief of the immediate banks of the rivers varies considerably. In most stretches gently sloping shores alternate with steep ones. There are places where vertical, bare rock cliffs will hinder cross-country movement considerably even when the surfaces of the rivers are frozen (FIGURE II-28).

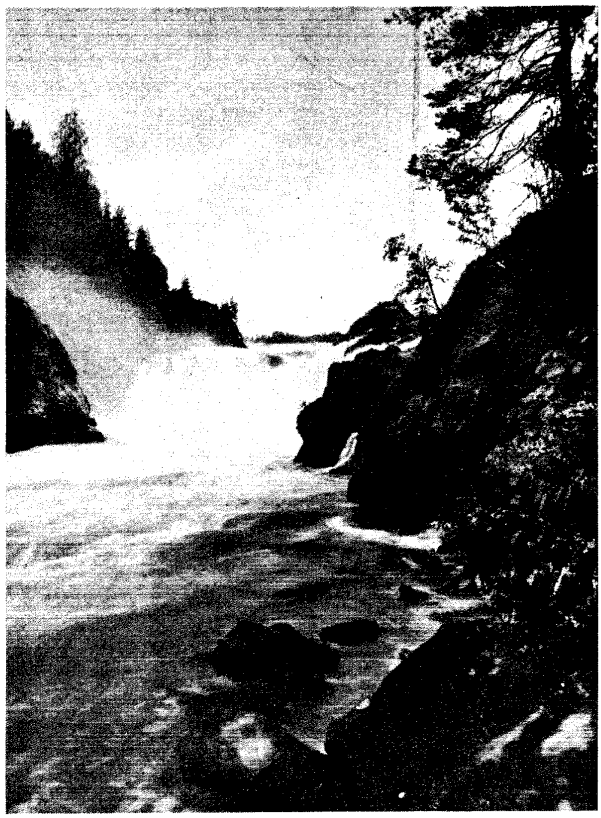

FIGURE II-28. *The Vodopad Kivach (Kivach waterfall) in the Suna river.*
The Suna empties into the northwest arm of Lake Onega. Waterfalls, narrow constricted valleys, and steep, rocky banks as in this view of the Vodopad Kivach (Kivach Waterfall) on the Suna are typical of rivers in the subregion. Before 1941.

Many large and small lakes occur in this area (FIGURES II-22 to II-26). The number of lakes in Karelia has been estimated to be as large as 35,000 and to occupy at least 12% of the territory. The lake area on the Kola Peninsula is about 5%, but a good part of this is made up by the large Ozero Imandra with its numerous appendages, Lovozero, Umbozero, Kolvitskoye Ozero, and Notozero. In the lake district the terrain is characterized by broad water bodies with many bays, peninsulas, islands, and isthmuses.

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Typical of most of the lake basins is their elongated, grooved shape. In south and central Karelia the lakes have dominantly northwest - southeast trend, which is continued in the many long, narrow, rocky bays on the west and northwest sides of Lake Onega. In north Karelia the most pronounced trend is east - west. Most lakes are grouped into systems, some of which consist of chains of lakes linked together by short channels; in other systems a central lake receives waters from surrounding ones and drainage to the sea is by one river. In marshy areas there are a number of small bog-lakes without visible outlets.

These lakes vary considerably in depth, but many have a maximum depth of 100 to 300 feet. Their water levels are said to be fairly even throughout the year and are reported to rise only about 3 to 4 feet during the spring high water.

As a rule, the shores of the lakes differ sharply. On their long sides, following the general trend of the relief, the shore for the most part rises rapidly for several yards; in places it consists of cliffs of bedrock (FIGURE II-29). On the short sides,the bottom of the lake shelves very gradually to the shore and there is a long, swampy lowland which prolongs the lake depression.

FIGURE II-29. *Ozero Imandra.*
A section of steep and rocky coast of Ozero Imandra shows in the foreground with a section of low, flat coast in the right background. This difference in the shore of the various parts of the lakes in the subregion is typical. In most cases, on their long sides, following the general trend of the relief, the shore rises steeply; on the short sides, there is a low, swampy, flat shore. Before 1941.

The lakes freeze over from the beginning to the middle of November and are covered with a firm sheet of ice for many months. The bearing capacity of the ice on the small lakes is high every winter. The ice cover of the lakes in the northern part becomes at least 3 feet thick and very strong. As a rule it is thickest in March. The ice is capable of supporting the heaviest vehicles as early as November or December and this capability continues until a few days before the break-up in spring. The lakes do not become free of ice usually until May or early June, three or four weeks after the large rivers are clear.

The lakes, plus the rivers and canals, form waterways which are the principal transportation network in the area (FIGURE II-30). This system is much used for floating logs. When unfrozen, the abundance of lakes is perhaps the most serious natural obstacle to military movement in this subregion. In the areas of greatest concentration of lakes it is impossible to maintain any definite direction of advance. Save for the ice-cover period, the deep, widely ramified lake chains, united by short, copious stretches of river, present serious impediments to movement.

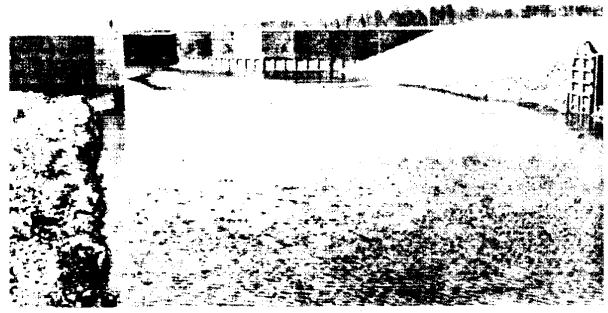

FIGURE II-30. *A lock in the Stalin Canal.*
The White Sea - Baltic Waterway, of which the Stalin Canal is a part, plus other canals, rivers, and lakes, forms the principal transportation network of the area. The White Sea coast and (Lake) Vygozero and Lake Onega depressions form an area of importance, since it serves as a major north - south corridor containing important sections of the White Sea - Baltic Waterway and the Kirov (Murman) railroad. Before 1941.

Outstanding in their importance in this area are, Lakes Ladoga and Onega which rank first and second, respectively, in size among the lakes of Europe. The former has an area of about 6,000 square miles, a northwest-southeast length of 130 miles, and a maximum width of 75 miles. The lake surface is only 18 feet above sea level. Lake Onega has an area little more than half as great but is some 10 miles longer. It has a maximum width of 53 miles. Because of their great size these lakes are major barriers to cross-country movement of vehicles.

The depth of Lake Ladoga is very uneven, and sharp changes in bottom slopes are common; the lake is particularly shallow in Shlissel'burg Bay. In general, the lake is shallow in the extreme south and deep in the north. The bottom shelves gradually to 200 to 330 feet in the middle of the southern half of the lake, and to a general depth of 500 to 700 feet farther north, with a maximum of 800 feet. Lake Onega has a maximum depth of about 260 feet and the greater part of the lake is between 70 and 130 feet deep; within a short distance of all the shores the water is more than 30 feet deep.

The seasonal range in water level of both lakes is about 7 feet. The level is lowest in April before the melting of snow and ice; following the melt, the greatest height is reached in May and June. The water is very clear and cold. Many rivers enter each lake. During the high-water stage a wide belt of lowland bordering the southeast shore of Lake Ladoga becomes flooded.

In Lake Ladoga the current is normally counterclockwise, but it is often disrupted by strong winds, which very quickly whip up waves over six feet high. Lake Onega has no pronounced current except in the middle of the lake, where it depends on prevailing winds, and near the mouths of rivers and the outlet into the river Svir'.

The shores of approximately the southern half of both lakes are low, mainly of sand and loam, in which are many large boulders; swamps or marshes occupy some sections. The shore lines are fairly regular and there are almost no islands. The northern shores of the lakes are high and steep, consisting mainly of bare bedrock. The Lake Ladoga shore is broken by numerous small indentations and in the north is fringed by many small, high, rocky islands (FIGURE II-31). The indentations of Lake Onega's northern shore, on the other hand, are featured by long, narrow bays or fiordlike arms, trending northwest - southeast, between peninsulas which project as much as 40 miles into the lake. Many small, rocky islands are scattered in these bays (FIGURE II-25).

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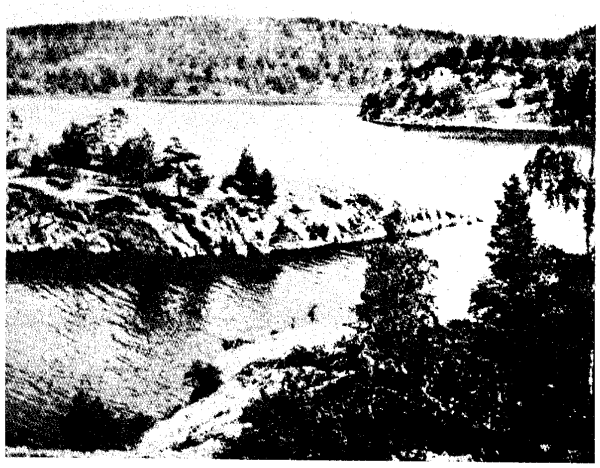

FIGURE II-31. *Northwestern part of Ladozhskoye Ozero between Yakkima and Lakhdenpokh'ya.*
The steep and rocky shores of this part of the lake are broken by numerous small indentations and are fringed by many small islands. Coniferous forests cover the land. Before 1941.

Ice generally appears in the lakes about the first of November, but sometimes earlier forming first in the shallow parts and near the shores. The northern part of Lake Ladoga, with its greater depth, seldom if ever freezes completely over; but in cases of very low temperature in December or January it has been known to freeze for a distance of 20 miles from shore. Only about once in 10 years does the shallower, southern part of Lake Ladoga freeze over completely to a thickness permitting it to be crossed by vehicles. This average was exceeded during recent years. In the Soviet-Finnish war of 1939-1940 motor sleds were driven across it, and during the German siege of Leningrad in 1941-1943 that city was supplied in winter almost entirely by means of a railroad laid across the ice from the vicinity of Sviritsa. The ice attains a thickness of 24 to about 40 inches but it does not remain smooth throughout the lake area. Over the shallows and reefs the ice sometimes piles up to a height of 15 to 30 feet, and during alternate periods of cold and warm weather strong winds form stacks of ice 70 to 80 feet high on the shores. Ice conditions on Lake Onega usually permit travel across the lake to begin about the middle of January in any direction. In the shallow southern end of Lake Ladoga the break-up of the ice begins in middle or late March. In the deeper northern parts of both lakes it is somewhat later and in some places ice may last until the middle of May.

These lakes are navigable nearly half the year. Owing to fogs and extremely violent gales, however, navigation is difficult at times. Petrozavodsk, on the Kirov (Murman) Railroad, is the chief port of Lake Onega.

Because of the difficulties of lake navigation and the shallowness of the southern end of Lake Ladoga the old Mariinsk Waterway, joining Shehbakov on the Volga with Leningrad, was dug slightly inland from the south shores of the lakes. Between the lakes this water route follows the Svir' river (140 miles), which is the outlet of Lake Onega to Lake Ladoga; from the latter lake the Neva river constitutes the final link to Leningrad. The route of the new White Sea - Baltic Canal system traverses Lake Onega from Povenetskiy Zaliv (gulf), northern arm of the lake, to the lake's outlet—the Svir' river. From the mouth of the Svir' around the southern end of Lake Ladoga to the Neva a new canal was dug which passes closer to the lake shore than the old Mariinsk Waterway.

An immense variety of swamps and marshes at normal level covers about 35% of the area. These wet lands not only cover extensive areas of the flat, rolling lowland, river basins, and other basins among the glacial ridges, and flat surfaces of the broad steps rising inland from the White Sea coast, but also large portions of the plateaulike watershed areas lying 500 to 600 feet above sea level. In spring some of these wet areas are completely covered with water for one to one-and-a-half weeks, sometimes to a depth of several feet, so that only isolated ridges rise above the water. In many sections most of the swamps and marshes have the same elongated shape as the lakes, since these swamps and marshes occupy either lake depressions overgrown with vegetation, or interridge areas.

The swamps and marshes freeze more or less in the same way as the other bodies of water. However, their freezing takes a longer time, and in certain places in spite of continuous cold weather, the ice formed on them during the winter is not thick enough to support heavy vehicles.

Within the wet lands are some marshes (or moors), which are somewhat better drained and therefore are comparatively dry. They are partially covered with dwarf bushes, including heather, marsh tea, and various kinds of berry bushes. The lumpy surfaces of these areas, however, although for the most part covered with a thick moss carpet, make travel very laborious. Such areas are easy to recognize by the brown-red color of the moss.

Other marshes, bushless and recognizable by their shiny, light-green-colored moss, are even more difficult to traverse, as one often sinks in up to one's knees. These marshes are often interspersed with over-saturated "trembling" or "quaking" sections (*zybuny* or *tryasiny*), which also are shiny and light green. They have only a thin, poorly consolidated moss cover on top of a deep layer of soft but sticky swamp muck. A break-through may be fatal. Long poles should be taken along in crossing such danger spots, which are usually marked by small open pools of water and patches of brown muck. Roads built across these areas must be supported by piles.

In crossing marshes on foot, it is advisable to keep to the tree-and-bush-growth in so far as possible and to watch for the brown-red and darker kinds of moss, indicating drier subsoil. Tussocks also indicate easier going for foot travelers.

The vast swamps and marshes are a considerable barrier to cross-country movement except in winter when they are firmly frozen. The unforested or sparsely wooded ones may then become the most favorable terrain for movement of all sorts. The swamps, marshes, and flooded areas which at times expand to about one-half of the area, are passable for all types of vehicles only on roads and small strips of dry terrain. In subfreezing weather they are passable for tracked vehicles.

Ground water is found at shallow depths in depressions and at variable depths in the uplands.

(c) Vegetation (PLAN 5).—Practically the entire area of subregion B-1 is covered by more or less continuous coniferous forests. These forests, however, have some variation in composition, size of trees, and density of stand (FIGURES II-19, II-20, II-24, II-26, II-27, II-28, and II-31).

The typical northern spruce forest, with some admixture of pine and birch trees, predominates in the Lake Ladoga - Lake Onega area. Here and there this forest has been thinned by lumbermen or by forest fires, but much of it is very dense. In this section a greater acreage has been cleared for cultivation than elsewhere in the subregion, but forests continue to predominate. The only part of the subsection in which broadleaf forests are found is in

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the extreme south, in the northern section of the Valdai Hills; here the forest is of mixed broadleaf and coniferous trees.

Forests in which pines predominate, with a small admixture of spruce, cover the general area of central and northern Karelia. The pine forest is in general more open than the spruce forest. North of the pine forests, across the southern and central parts of the Kola Peninsula, spruce again predominates. However, this spruce forest is very sparse and the trees are only 15 to 25 feet high. North of this second spruce belt is a narrow strip of pine forest, bordered on the north by a narrow strip of birch forest.

The northern forest limit is not sharply defined, the transition to the tundra of Region A taking place in a belt of forest-tundra having a maximum width of 25 miles, over which grow patches of sparse, dwarf birches.

In the Ozero Imandra district the pine strip is missing, and the spruce forest merges with dwarf birch growth about five miles south of the town of Kola. Along the north side of Kandalakshskaya Guba, there is a large area of pine forest, which at some places reaches through to the Murman coast tundra. In general, however, the spruce and birch extend farther north than the pine.

On the mountain slopes the upper limit of the forest varies with the locality. In the far north in the vicinity of the town of Kola it is very low, being about 560 feet above sea level. In the interior of the Kola Peninsula, where the summers are warmer, spruce and pine forests grow much farther up the mountain slopes; there they are succeeded by a scrub-birch zone 300 to 500 feet in vertical width. These birches sometimes form quite impenetrable thickets, with dense crowns 7 to 10 feet high. Above the scrub-birch zone "high tundra" (grasses, herbs, lichens, and mosses) prevails, such as is on the Chuna, Khibinskaya, and Lovozerskiye tundras (FIGURES II-21 to II-23). On the southern slopes true forest often reaches up to 1,500 feet above sea level, but on the northern slopes it frequently ceases at 800 feet above sea level. South of the Kola area, few mountains extend above tree line.

In the dense spruce forests of the southern part of this subregion the undergrowth is relatively slight. The ground is covered with an almost unbroken carpet of green moss and there are many berry bushes. The predominant ground cover in the pine forests of central and northern Karelia is white reindeer lichens, above which is a fairly thick growth of a variety of shrubs. Undergrowth develops to a greater extent in the forests of the Kola Peninsula, where much of it consists of dwarf birch, usually dense in the vicinity of streams and lakes; locally in many places the birch exceeds even the coniferous forest in growth. Bordering many of these streams is a narrow, damp, almost impenetrable band of willows with occasional birches. The lakes are bordered with a similar, though less developed, bush growth. In many places behind these thick bands along rivers and lakes stretch broad, marshy meadows. Blueberry and raspberry bushes are numerous throughout much of the undergrowth of the Kola Peninsula, as are mosses, marsh tea, and other low-growing plants.

The forests constitute a major barrier to cross-country movement and the use of mechanized equipment. In most places, except where the land has been cleared or thinned by lumbermen and farmers, or by forest fires, the forests impede traffic. In the more open parts of the forests, where equipment might pass or men filter through, visibility is limited by the undergrowth. Traffic is further impeded by the swamps and marshes, which have varying degrees of passability. Entangled undergrowth and masses of half-rotted, moss-coated, fallen timber block the way at many places. Furthermore, extensive accumulations of boulders and stony talus cover many of the slopes, which are mostly overgrown with damp, slippery moss and present great difficulties for rapid movement.

The vegetation of the swamp and marsh areas which cover about 35% of the subregion has been discussed in the swamp and marsh section of drainage conditions.

This subregion is only thinly populated, and agriculture is very little developed. The southern boundary of subregion B-1 coincides in general with the southern boundary of the areas predominantly forested. Fairly large areas of the forest have been cleared in the Lake Ladoga and Lake Onega lowlands (FIGURE II-32) and along the railroads. In the rest of the area, cultivated land is found only along the lakes (FIGURE II-24) and larger rivers. Meadow areas also are found here and there along the streams. Rye, barley, and oats are the main crops. The cultivated vegetation is not tall enough or dense enough to impede military traffic.

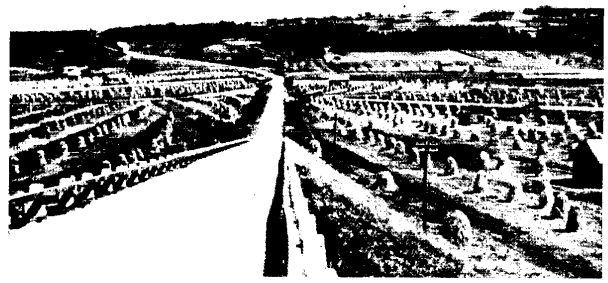

FIGURE II-32. *A typical landscape of cultivated fields west of Lake Ladoga near Valkjärvi.*
Probably looking eastward. This rolling surface with northwest-southeast trending valleys has been partially cleared and contains numerous cultivated fields. Before 1941.

(d) Trafficability of surface materials (PLANS 6 to 9).—The dominant surface materials of this subregion consist of glacial clay, sand, gravel, and boulders. These materials are spread mainly in varying thicknesses over the country up to elevations of about 1,300 feet above sea level, and in some cases to an altitude of 2,000 feet. The unevenness of the mantle is emphasized by the hills and the many long, narrow, irregular ridges of glacial deposits found throughout the lowland sections. In other places the glacial cover is not present and the bedrock outcrops in more or less extensive areas. Smooth rock surfaces predominate on the knobs of hills and mountains, and where rocks form the numerous rapids and waterfalls in the rivers.

The soils of much of the glacial area are sand or a mixture of sand and loam over the coarser sand, gravel, and boulders of the glacial debris. Locally soils of silt or clay have developed. Loose stones and boulders are common on and in all the soils. Very great obstacles to traffic and cross-country movement are presented by the numerous boulders, which are widespread at the foot of the mountain tundras, rocky hills, and glacial ridges.

Drainage is a major factor in the trafficability of this area. Sections of well-drained soils are very limited and discontinuous; they include the mountains in the vicinity of Ozero Imandra, parts of the undulating plains of glacial till which are scattered mainly throughout the southern and eastern parts of the area, and the numerous glacial ridges of irregular serpentine course.

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Small strips along the flat coastal plain of the White Sea and large lakes are formed of sand, loamy sand, or sandy loam over deep stratified sands or stratified sands and silts. These strips are in general well drained, but within them are numerous swampy areas, with poorly drained soils of silty sand and clay with a high proportion of peat.

The lowland sections or depressions have mainly poorly drained, loamy, silty or clayey soils with numerous areas of peat. The peat soils predominate to a large extent in the lowlands which have been formed by the choking up of former lakes and swamps. These depressions are not always wet.

Soil trafficability is greatly dependent upon seasonal climatic conditions. The swamps, marshes, and muddy areas generally freeze solid in winter and thus cease to be the obstacle to cross-country movement that they are during the warm season. However, the freezing of these areas takes longer than the freezing of lakes and rivers; and in certain places, in spite of the continuous cold weather, the ice formed on the swamps and marshes during the winter is not strong enough to support heavy vehicles.

The surface of the ground is probably frozen firm in the south from the middle of November to the end of March. In the north the surface is frozen for a few weeks longer, from the end of October to the beginning or middle of April. Occasional thaws occur toward the beginning and end of this period. The ground is most firmly frozen during the months of December, January, February, and March. No permanently frozen subsoil has been reported anywhere in the area. When the ground surface is frozen it can support heavy vehicles.

Sections which are difficult to traverse at any time become almost absolutely impassable even for foot travel during the spring thaw (muddy season), occurring during late March, April, and May in the south and during mid-April, May, and June in the north. At this time the few paths which lead through the swamps are covered by water, and unsurfaced roads become practically bottomless. Other strips of land which are ordinarily dry in these generally wet sections become muddy and swampy. According to the experience of the Germans, the surface is then passable to a limited degree for full-tracked vehicles except in gullies, for half-tracked vehicles only in higher sections. Movement of other vehicles must be confined to the few hard-surfaced roads available.

Late spring, summer, and early autumn rains soften the ground and the unsurfaced roads. Because of the widespread, poor-to-moderate drainage conditions and the frequent rainfalls during the spring, summer, and fall seasons, completely dry surface conditions are infrequent, or continue for short periods only, except on local areas of well-drained soils. During the months of heaviest rainfall, June to September, even the unsurfaced roads are not usable for rapid movement; tracked vehicles can move over the roads only with great difficulty. The muddy period in the autumn is not nearly as severe as the period in spring or summer.

Abundant stone, gravel, and sand are available throughout the area for use as road-building material and for other construction purposes. The hard bedrock surfaces do not lend themselves to rapid road construction.

(3) Subregion B-2, the Northern (Severnaya) Dvina-Pechora Basins and Hills (PLAN 2)

Lying east of the Kola - Karelia Hills and Lowlands subregion (B-1) is the Northern Dvina - Pechora Basins and Hills subregion (B-2); it is about three times the size of the land area of subregion B-1 and constitutes the remainder of the Northern Forest Belt (Region B). The Tundra Belt (Region A) borders subregion B-2 on the north and the southern boundary is near, but south of, the Volga - Arctic divide. On the east subregion B-2 is limited by the JANIS boundary.

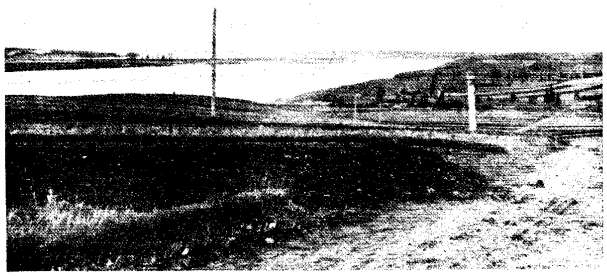

FIGURE II-34. *Northern Dvina-Pechora Basin.*
The Severnaya Dvina - Pechora Basin along the Mezen' river between Yuroma and the town of Mezen' is an undulating plain of moderate elevation. It has been cleared of forests and is partly under cultivation. Before 1941.

FIGURE II-35. *Upper Valley of the Vychegda at Vol'din.*
The Vychegda is an eastern source stream of the Northern Dvina. This stream cuts through an undulating plain covered with scattered areas of low hills and ridges. Before 1941.

(a) Relief (PLANS 2 and 3).—The Northern Dvina - Pechora Basins and Hills subregion is essentially a plain of moderate elevation, rising very gently toward the southeast and east, where it merges with the northern Ural Mountains (FIGURES II-34 to II-36). The general uniformity of the surface is broken mainly by the much worn-down belt of Timan Hills (Timanskiy Kryazh), which crosses the subregion diagonally from near Chëshskaya Guba southeastward to the JANIS boundary, and by the northern Ural Mountains which rise along the northern section of the eastern regional border. Also, belts and clusters of low, sand-gravel hills are scattered over the major basins. Five relief districts of the subregion may be recognized. They will be discussed separately.

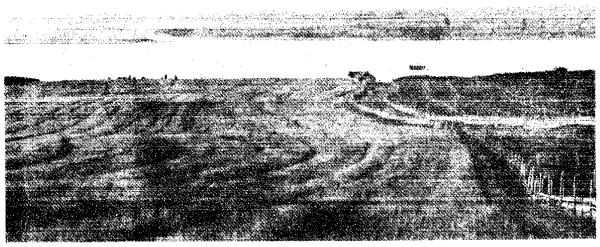

FIGURE II-36. *Vychegda valley at Aykino.*
View southeast across the gently sloping terrain on the high right bank toward the lower alluvial plain containing abandoned stream beds and lakes. Before 1941.

In the northwestern and central parts of the Northern Dvina Basin the terrain alternates between wide river valleys, or lake basins, and clusters of generally northeast - southwest trending hills (B-2a). The gently rounded hills reach elevations of 500 to 800 feet above sea level, but they rise only 150 to 250 feet above the adjacent lowlands. The lake basins of the southwest, and the portions of the Onega, Northern Dvina and Mezen' river basins are 25 to 60 miles broad, and their sides descend in a series of wide, gently sloping steps (FIGURE II-36). These lowlands are very poorly drained. Cross-country movement within the Northern Dvina Basin is limited in summer by the poor drainage, and, as a result, possible movements are confined to short traverses of the sand-gravel hills and to longer journeys along the rivers and the elevated sections of their banks.

In winter movement of moderately heavy vehicles is possible on the ice-covered streams and lakes and along trails through the woods. However, corduroy or mat reinforcements must be placed over many of the thinly frozen bogs in the lowlands.

The broad, east - west belt of swells, which occupies the eastern part of the southern border of the subregion, constitutes the Volga - Arctic Divide area. Its general elevation is about 800 to 1,000 feet above sea level, and it is cut into large blocks by wide, sand-filled, poorly drained valleys. The tops of the blocks are gently undulating, with scattered sand and gravel hillocks. Many of these upland surfaces are also poorly drained. The major valleys, which separate the blocks, are 2 to 6 miles in breadth, and are flanked by a series of sand and gravel terraces. The minor valleys, which are cut across the river terraces and into the blocks are narrow, steep-sided, and generally free of terraces. Cross-country movement over the area of the Volga - Arctic Divide generally is confined to the terraces in the major valleys and to the somewhat elevated sandy banks of the larger streams.

The Timanskiy Kryazh (B-2c) formation is a worndown series of northwest - southeast trending uplands (FIGURE II-37). In part these uplands, which form the watershed between the Mezen' - Northern Dvina and Pechora systems, are little more than a broad plateaulike swell. Elevations reach 800 to 1,000 feet above sea level and rise only 200 to 400 feet above the adjacent valleys. Over the solid rock base of the hills is a thin cover of loose soil and stones. Major valleys in the Timan Hills are 20 to 40 miles in breadth and rise gradually in broad terraces to the edges of the old rock platforms, where there are rather sharp, rocky shoulders 150 to 250 feet high. The lesser valleys are much like the major valleys but are on a smaller scale. Movement is easiest along the lower, flatter slopes of the solid rocky ridges.

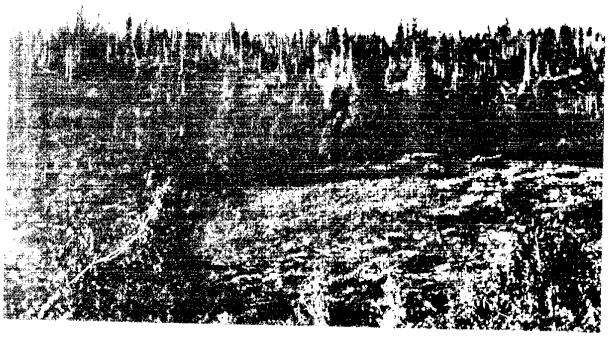

FIGURE II-37. *The Timan Hills.*
The Timan Hills consist of undulating-to-slightly-hilly terrain. Forests, mainly spruce and some birch, have been thinned by forest fires. Before 1941.

The Upper Pechora Basin (B-2d) occupies a large triangular area in the northeastern part of the subregion. Throughout most of its extent the basin is a gently rolling plain rising to 600 or 700 feet above sea level in the south. However, in the east, toward the Northern Urals (B-2e) the plain is more dissected and somewhat higher. There it reaches elevations of 600 to 1,000 feet above sea level. The general level of the plain is broken by a series of rounded swells which rise slightly above the plain and the broad valleys (10 to 40 miles wide) of the Upper Pechora system. These valley bottoms lie 100 to 250 feet below the general level of the plain. West of the Pechora, these swells are parallel to the Timan Hills but east of that river the elevations are parallel to the Urals. These low folds have fewer sand and gravel hillocks and are considerably better drained than the Northern Dvina Basin to the west (B-2a). If it were not for the dense forests in the Upper Pechora Basin, cross-country movement would be fairly easy on the comparatively well drained swells.

Most valleys in the Upper Pechora Basin are wide and flanked by terraces. However, both the inner valley flats and the terraces are occupied by extensive swamps, marsh areas, and dense forests.

In the eastern part of the subregion, a foothill ridge of the Urals extends from south to north between 62° N. and 64° N. It is an elevated area of widespread limestones, sandstones, and clay schists. The limestone region has an extremely uniform relief but limestone caves, sinkholes, and underground streams are common. All the watersheds in it are relatively level and have a general altitude of 600 to 800 feet above sea level. Rivers have cut into this elevated plain and formed narrow valleys, with high, sheer embankments.

The valleys in the sandstone and clay schist zone, and in the eastern margin of the Pechora plain, are accompanied by as many as four terraces, with heights of 15 to 20, 33 to 40, and 55 to 65 feet above the river. The flood plain, 3 to 10 feet above the stream, is very narrow and poorly developed in contrast to the wide flood plains elsewhere in the subregion. The rivers of the Pechora basin are at present in the stage of deepening their beds. In the limestone region the terraces are inconspicuous because of the narrowness of the valleys. Eastward from the foothill ridges, the Ural Mountains rise abruptly above the extensive Ilych lowland. Cross-country movement is easiest along the bases of slopes and on the terraces. However, cross valleys, which are cut into slopes and terraces, and the rock debris on the slopes, greatly restrict the speed and range of movement.

The section of the Northern Ural Mountains included in this subregion consists of two parallel ridges, the eastern one of which forms the drainage divide between the Pechora and Ob' rivers, despite its lesser height. These Northern Urals have a total breadth of 24 to 25 miles, and the north - south, lengthwise valleys between the two chains are 3 to 7 miles wide. The two chains are heavily dissected by the Pechora river system on the west. The western chain is broken up into numerous detached elevations, among which the sharp, rocky peaks, located about 64° N, reach 5,470 feet. The average elevation of the Urals farther south is only 2,400 to 2,800 feet. The passes in the Northern Urals lie at altitudes of only 1,300 to 2,000 feet above sea level.

The main chains are flanked on the west and east by lower ridges and foothills. Like the western chain, the

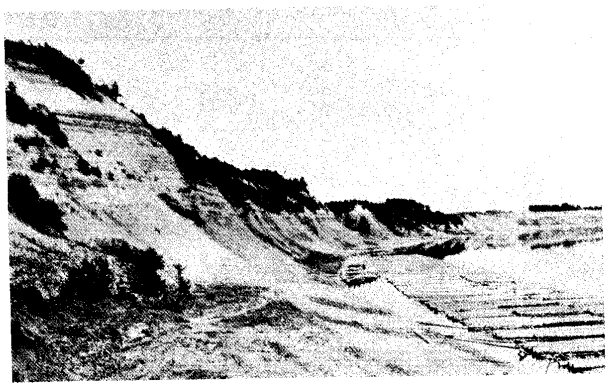

FIGURE II-38. *Lower Sukhona river near Velikiy Ustyug (Severodvinsk).*
View downstream of the Sukhona river, western source of the Northern Dvina a few miles above the mouth of the Yug river, near Velikiy Ustyug. The steep, left bank of the stream is composed of marl. Before 1941.

western foothill ridges are broken up into detached blocks of sandstone, called *parmas,* ranging from 1,000 to 3,000 feet in height.

(b) Drainage (PLAN 4).—With the exception of small portions of the southern borderland of the Northern Dvina - Pechora Basins and Hills subregion, the entire area drains northward into the White and Barents seas. The major streams, such as the Onega, Northern Dvina, Mezen', and Pechora, flow in a general north - northwest direction, and divide the plain into a series of extensive, low swells. Movement between these higher interstream areas is impeded more by the broad marsh and swamp zones in the valleys than by the streams themselves. Steep banks along the streams form secondary local barriers to cross-country movement (FIGURES II-38 and II-39).

FIGURE II-39. *Steep bank of the Pinega river.*
The Pinega river is the main right tributary of the lower Northern Dvina. In this view, near Karpogory, the steep bank containing loose stones is almost devoid of vegetation. Movement across such river banks would be channeled through breaks in the embankment. Before 1941.

Movement across streams, marshes, and swamps is greatly facilitated during the winter season, when they are frozen hard. For example, in the northern part of the subregion, ice reaches a thickness of 27 inches in late winter (March). In general, the season of deep frost lasts from late October or the beginning of November until late April and early May. As in other parts of the northern USSR, many of the moss- and forest-covered bogs underlaid by peat, are so insulated by their cover that the frost does not penetrate deeply. As a result, any roads constructed on this formation would not support heavy equipment unless the insulating layers were stripped off and several days elapsed, during which the frost could penetrate deeper into the ground.

The ice breaks up on the streams during April, May, and early June. This break-up starts on the headwaters because of their more southerly location. During this period great ice jams form in the middle and lower sections of the streams and large areas of the wide valleys are flooded to a depth of several feet. The volume of these spring floods reaches immense proportions as a result of the melting of the snow cover, which averages 24 to 27 inches. These spring freshets, with their ice jams and floating ice, last to the middle or latter part of June, after which the streams gradually carry off the flood waters from the inundated valleys, and remain at or near high-water stage until the latter part of July. In late summer and fall (August to early October) the streams are at low-water stage, but the swamps and marshes remain as major barriers. Myriads of mosquitoes, flies, and gnats are present in these poorly drained areas.

The lakes in the southwestern corner of the subregion (Beloye, Vozhe, Lacha, and Kubenskoye) are shallow and usually have flat, sandy shores. The lakes have a freezing and flooding regime similar to that of the rivers and consequently expand and contract greatly in depth and area.

All the rivers of the Northern Dvina Basin (B-2a) have a large number of meanders, and flow through broad valleys, which in spring are flooded over vast expanses. Even the major streams are shallow at low water (two to three feet), and at many places sandbars and sandy islands project above the water. The number of sandbars and their locations change every year, hampering the use of the rivers for navigation. During high water, minimum depths reach 4 to 6 feet.

On the Volga-Arctic Divide (PLAN 2, B-2b), the slight permeability of the subsoil and the relative abundance of precipitation, which averages from 20 to 22 inches, cause considerable swampiness. The rivers have a somewhat smaller run-off than the remainder of subregion B-2. The rivers are full in the spring and very shallow at mean low water.

In the Upper Pechora Basin (B-2d) the precipitation is less abundant, but the run-off from the Northern Urals supplies the Pechora system with sufficient volume to create great floods in spring dammed up behind the frozen northern reaches, and to maintain high-water levels throughout the summer and autumn. The Pechora also has a considerable number of sandbars, and its channels frequently shift.

All of the streams of subregion B-2 are practically unregulated. Bank reinforcements against the powerful ice jams and spring floods exist only over short stretches near the largest towns.

The river Onega, in the western part of the subregion, is 250 miles in length; and is the outlet for lakes Vozhe and Lacha in the southwestern part of the area. The river's breadth increases from 150 or 200 feet near Ozero Lacha to approximately one mile at the point where the stream leaves the subregion. Maximum depths vary from 12 to 25 feet in summer to 16 to 43 feet during spring floods. Minimum depths over sandbars vary between three and six feet. The bottom of the Onega is sticky mud almost everywhere. There are many rapids, the first

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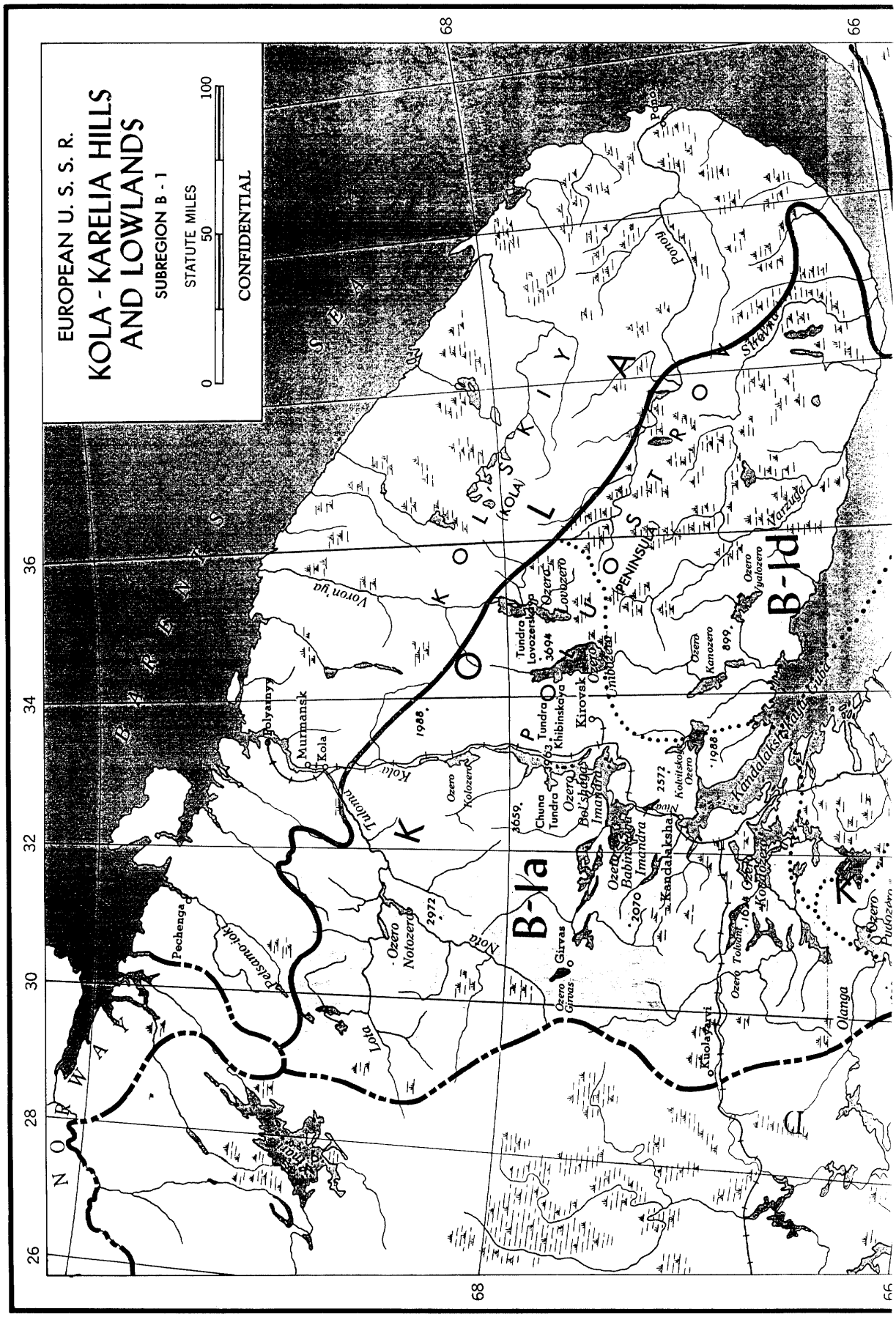

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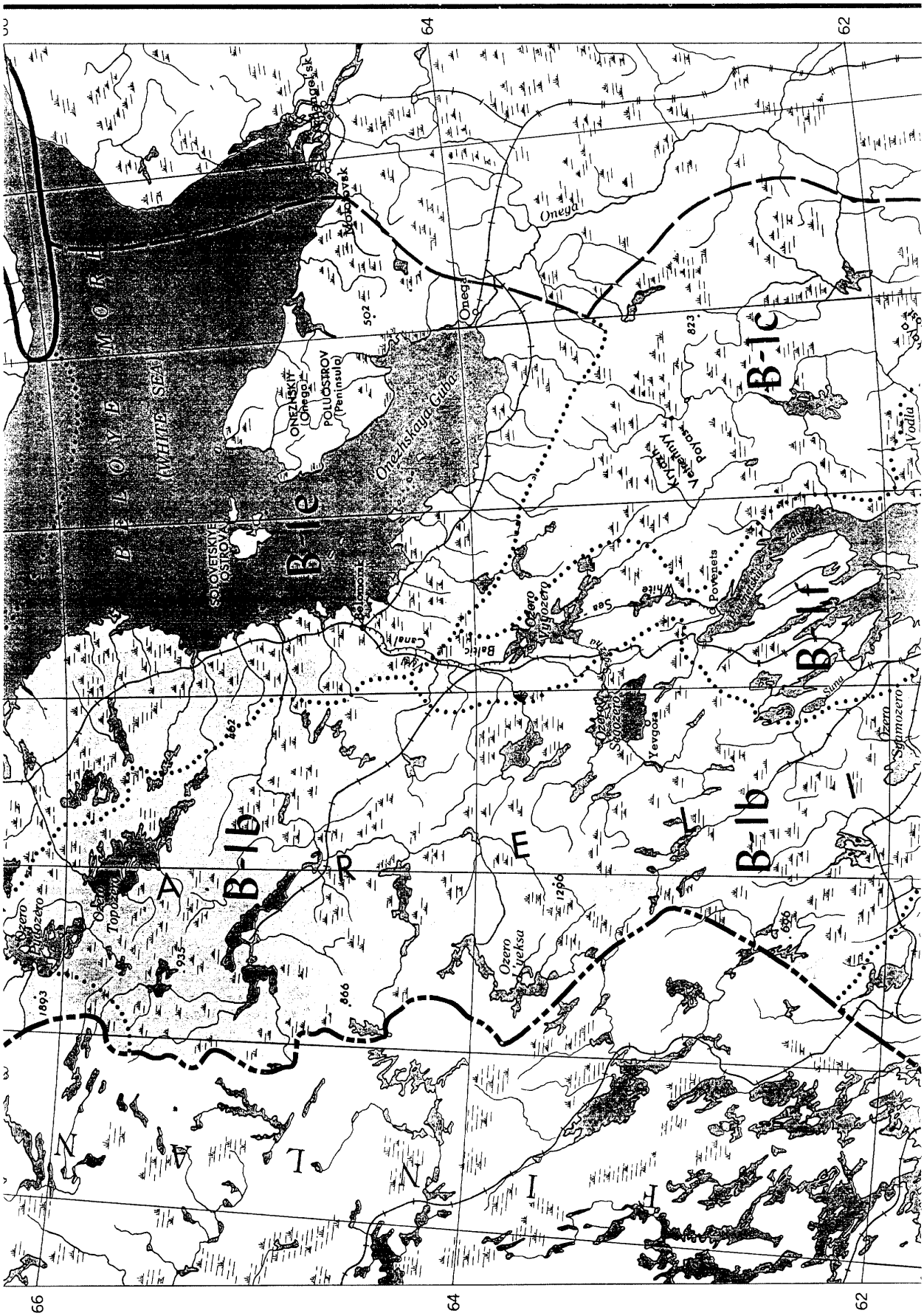

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FIGURE II-33
KOLA-KARELIA HILLS AND LOWLANDS
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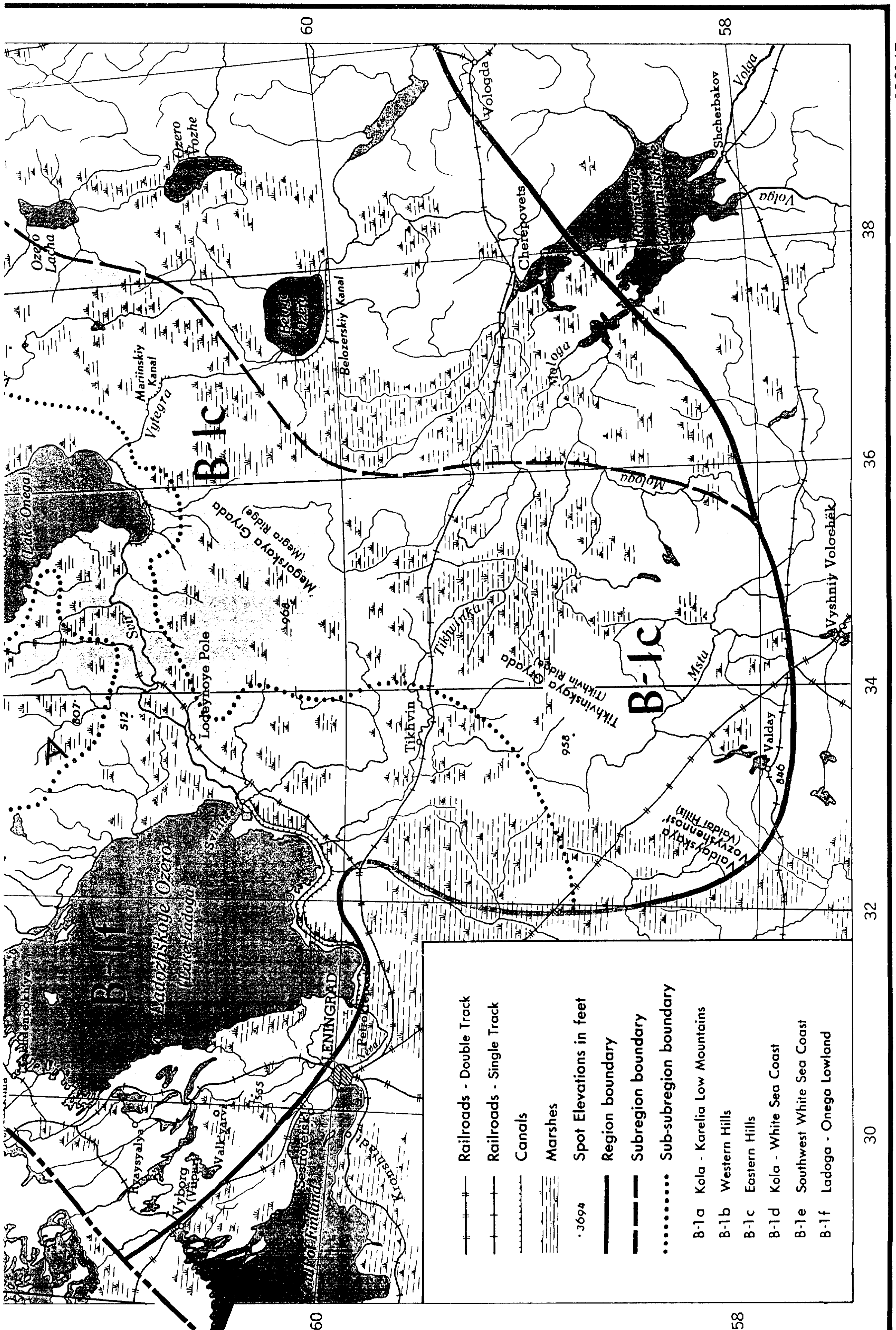

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FIGURE II-40. *The Northern Dvina at Verkhnyaya Toyma.* View upstream from the steep, east bank toward the large, sand islands in the river. Before 1941.

being only 8.5 miles above the mouth. As a result of these rapids and the swift current of the Onega, it is little used for navigation and forms a considerable barrier to cross-country movement, except when frozen (November to May).

The Severnaya Dvina river (FIGURE II-40) is one of the larger rivers of the USSR, draining 140,000 square miles, an area only slightly smaller than California. The Severnaya Dvina is the old historic trade route to the Arctic first followed by the Muscovites, and the port of Arkhangel'sk at the mouth of the Dvina was the first gateway through which old Russia established direct trade relations with the Atlantic countries. The Northern Dvina, together with its largest source stream, the Vychegda, is 1,100 miles long. The Northern Dvina system varies in width from 1,000 to 1,600 feet in its upper reaches (Sukhona and Vychegda) to an unencumbered channel two miles in width near Arkhangel'sk. In its lowest reaches, the river forms a delta and breaks up into a series of channels each one-fourth to one mile in breadth, and the total width of the channel is 2 to 10 miles. The depths vary tremendously, but critical minimum figures are 6 to 8 feet over the sandbars during the spring floods (May and June) and only 2 to 3 feet in the shallows in late summer (August and September). Many stretches of the river have depths of 18 to 25 feet in summer and 40 to 75 feet in spring. The bottom is predominantly sandy, but in the lower course finer material replaces the sand in part. There are many sandbanks, which change their locations every year, especially in the upper course. The banks are sandy, steep, and generally high (FIGURES II-38 to II-40).

At some places on the lower course the banks consists of great strata of limestone, gypsum, and alabaster. The banks are generally free of timber and have villages of considerable size every few miles. There are no rapids on the Dvina and its main tributaries until the uppermost headwaters are reached. The Northern Dvina is still an important trade route, used by large powerboats and many rafts. The main barrier effects of the stream are the multiple channels, the great spring floods, and the extensive swamps and marshes, particularly along the left bank. The stream and adjacent swamps and marshes are frozen to a considerable depth from late October to April-May. By mid-January the ice is 2 to 2.5 feet thick at Arkhangel'sk.

The river Pechora has a total length of approximately 1,200 miles, of which about 1,000 miles lies within subregion B-2. It drains an area of 120,000 square miles, of which over 100,000 is in subregion B-2. In its upper reaches the Pechora is 200 to 500 feet wide, and this width increases nearly a mile below the mouth of the Usa. One or two constricted areas in this lower section have widths of 2,000 to 2,500 feet. Mean depths are 6 to 8 feet in the upper course and 10 to 15 feet in the lower. Minimum depths in these sections are 3 to 4, and 7 to 8 feet. The bottom is mostly sand and gravel. The banks of the Pechora vary greatly in height, but in general the right bank is high and sloping; in some places it forms bluffs of 100 to 250 feet. The left bank varies from 20 to 100 feet in height on the upper and middle reaches, but is only 5 to 10 feet above mean water level in the last northward stretch below the mouth of the Tsil'ma. The only rapids on the Pechora are on its uppermost reach, where it descends from the Northern Ural Mountains and enters the extreme southeastern corner of its basin (PLAN 2, B-2d). Like the Northern Dvina, the Pechora, with its great width, high banks, and poorly drained valley, is a considerable barrier to cross-country movement except in midwinter, when the waters are deeply frozen. The Pechora can be navigated by river boats throughout subregion B-2 and is so utilized by the Soviet authorities.

The upper courses of the rivers on the west slopes of the Northern Urals usually have a gentle fall and broad valleys. Down stream (northward), the rivers become genuine torrents and break through the western foothills in narrow defiles. Characteristically, they flow alternately through lengthwise and transverse valleys. These streams are not navigable, but their narrow valleys form the main passageways across the Northern Urals.

As the western slope of the Northern Urals is composed of hard and mostly water-impermeable rocks, the water table is everywhere near the surface. However, the considerable steepness of the slopes does not permit the water to accumulate or stagnate. Any excavations made in the thin soils of these slopes could be easily drained.

(c) Vegetation (PLAN 5).—On the northern edge of the Northern Dvina - Pechora Basins and Hills subregion (B-2), the forest-tundra gradually merges southward into very sparse, swampy, weak-trunked spruce forest, the type most widespread in the basin of the Pechora. The comparatively low, thin woods here have an undergrowth of the small shrubs, herbs, mosses, and lichens common also to the forest-tundra. This type of forest occupies a zone 25 to 60 miles broad, extending south from the northern boundary of Region B to the river Peza, an eastern tributary of the lower Mezen'.

Under favorable conditions of drainage, shelter from the winds, and other factors, the virgin forest penetrates into the tundra zones on sandy, better-drained areas, through valleys of the large rivers, and over sheltered loamy slopes. Along the gulches and small stream valleys, on the other hand, the forest tends to recede to the south.

Farther south, approximately between the 65th and 60th parallels, runs a broad strip of forest *(tayga)*, in which spruce forests predominate, alternating with pine forests which are in general on sandy soils and in localities adjacent to rivers. Siberian species of spruce, larch, and fir are common in the east, but they gradually disappear toward the west in favor of European species of spruce and fir; in the west the larch vanishes altogether. Though widely distributed, the larch rarely predominates, but as a rule is sprinkled among pine stands. Broadleaf trees are lacking, save for very rare occurrences of linden, and birch, aspen, and willow in the west. Peat moss occupies large parts of the poorly drained areas throughout subregion B-2.

Along the southern boundary of subregion B-2, in general south of the 60th parallel, the somewhat less swampy

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southern *tayga* is also dominated by spruce. However, it has a notable admixture of broadleaf species, chiefly linden and maple. In this southern *tayga* the swamps and moors tend to be of the bushy type. Also, the undergrowth is more dense than farther north.

Unlike other parts of the virgin forest belt of subregion B-2, that of the Northern Urals is characterized more by larch forests than by forests of any other species. The larch grows on the bedrock outcrops and everywhere forms the upper timberline. These trees attain a considerable height under the most favorable conditions, but become typical brushwood toward their upper limit. Larch forests reach northward all the way to the head of the river Kara, where they occupy only the passes. In the latitude of Gora Pay-Yer (67° N), the timberline reaches 1,000 feet, and around the headwaters of the Pechora the Urals are forested to the very top. Larch is a needleleaf or coniferous tree, but unlike most coniferous trees, it loses its leaves in winter, reducing the possibility for winter concealment.

FIGURE II-41. *Dense forest at Vel'sk.*
The dense forest cover would impede cross-country movement. Photograph shows a tall forest of spruce, aspen, and birch near Vel'sk, a lumbering center on the new railway between Konosha on the Arkhangel'sk railway and Kotlas on the Severnaya (Northern) Dvina.

In general, throughout the subregion, the virgin forest forms a dense cover (FIGURE II-41). Branches grow low on the trunks, and restrict horizontal observation. Not only is the tree stand relatively dense, but there is much underbrush in the southern areas and much moss-covered, fallen timber in the central and northern portions. There are some major breaks in this forest growth. These consist of strips of meadow along the main streams (FIGURE II-42), large, irregularly shaped moors underlaid by peat in the flooded valleys and on the more level divides, and the almost unwooded north and east slopes of the Timan Hills (FIGURE II-37). Most of the meadows are marshy in spring and early summer.

In spite of the complete lack of care, the quality of the timber is good wherever the trees grow on soil sufficiently sloping to have good drainage. Owing to the slowness of its growth, such wood is very firm and durable and hence especially prized on the world market. In the lowlands and on the almost level watersheds the forests are very swampy, so that the trees have weak trunks, are poorly developed, and provide low-quality wood.

The entire virgin forest belt offers very few points for orientation from the air. At a low level, the immense forest appears to be almost without reliable landmarks. From high altitudes, the broad streams and especially the larger lakes will serve to orient the flier to a certain

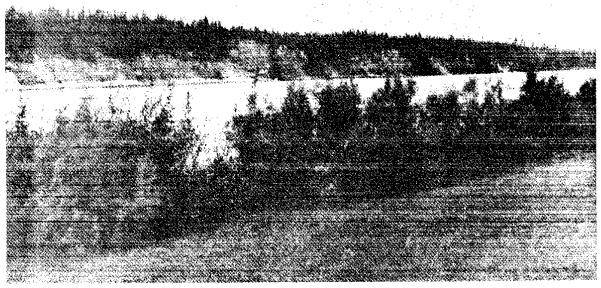

FIGURE II-42. *Lower Pinega at Soyala.*
View from the low, left bank toward the high, gypsum cliffs of the right bank. Meadow and willow vegetation covers the damp, low, left bank, whereas coniferous growth covers the better-drained right bank. Before 1942.

extent. The smaller rivers and lakes look so much alike and many of them are so inaccurately recorded on existing maps that they are useless for orientation.

(d) Trafficability of surface materials (PLANS 6 to 9).—Surface materials in the Northern Dvina - Pechora Basins and Hills subregion have not been studied in detail, but in general on the hills and swells they are sand, gravel, and in places solid rock; in the lowlands they are sand and clay, overlaid to a large extent, by marl and muck. A thin top cover of light-gray, powdery, loam-like soil overlies heavy clay or sand-clay subsoil on some lowland and lower slope areas. With the exception of the solid rock ridges, along the northwest border and in the Timan Hills, most of these soils are deep and loose enough to be excavated readily. However, power shovels would be necessary to break such soils when they are frozen hard, i.e., from October to late May. Due to the generally poor drainage, most excavations in the lowland areas and on some of the more level upland blocks would quickly fill with water as soon as the ground thawed.

Throughout the northern Dvina Basin area (B-2a) sand-gravel ridges are covered by light-gray loamy soils and the lowlands by muck soils. Along the western boundary of the subregion there are occasional patches of bare gypsum and limestone. In these limestone and gypsum formations there are great numbers of funnel-shaped sink holes as much as 50 feet deep and 70 feet in diameter, and limestone caverns. Roofs of some of the caverns have collapsed, creating long, irregular trenches as deep and wide as the sinkholes.

The Volga - Arctic Divide (B-2b) in general has sand and gravel soils in the wide valleys. Some of these sands and gravels are overlaid by several feet of muck. On the rolling surfaces of the upland blocks, clays, loams, and thin sand deposits are common.

The Timan Hills area (B-2c) has many gently rounded, bare rock ridges. Most of these rocks are hard and difficult to quarry. The thin soils of the lower slopes and valleys are chiefly sand and gravel, with patches of muck in the poorly drained areas. Along the slopes and their bases there are extensive fields of angular blocks of rock, some of which are several feet in diameter. These materials greatly restrict movement of vehicles on these slopes, which are the driest and otherwise most favorable areas for movement, and give some horizontal cover.

The Upper Pechora Basin (B-2d) has widespread areas of thickly bedded sand and gravel with layers of clay and sandy loam. In the valleys these materials are mixed and are frequently overlaid by muck in the swamps and marshes.

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The soil cover in the Northern Urals is predominantly a thin mantle of fine, rubbly earth. Clayey and sandy-loam soils are found in the valley of the upper Pechora. In the Northern Urals, even more than in the Timan Hills, loose rocks, including large, angular blocks, accumulate on the slopes and particularly along their bases. Since many of these blocks are several feet in diameter, the resulting rock piles constitute serious obstacles to movement along the more gently inclined lower slopes. Some of the valley floors are covered more or less completely with these large rocks and, as a result, are nontrafficable.

C. Region C, Forest and Clearings Belt

(1) Introduction

Region C, the Forest and Clearings Belt, forms a broad wedge-shaped band which tapers gradually from west to east across all south-central European USSR. The Region lies between the Northern Forest Belt (Region B) on the north and the Ukrainian Carpathian Mountains (Region D) and the Grassland Belt (Region E) on the south (PLAN 2).

The Forest and Clearings Region is surrounded by other Soviet territory, except on the west where the Region fronts on Rumanian and Polish lands and the Baltic Sea. However, these western border lowlands and seas are under Soviet control at the present time (July 1947). Consequently, in spite of its large size, this region is relatively inaccessible in the political-military sense. Physically, in contrast, the Forest and Clearings Belt is relatively accessible on the west where it fronts directly upon the North European (German-Polish) Plain and the navigable Baltic Sea, and on the south where the region merges with the gently undulating plains of the Grassland Belt. The Region extends 1,200 miles from east to west. From north to south it measures 950 miles on the west (Leningrad to Kishinëv (Chĭsinău)) and 475 miles on the east (Kirov to Saratov). The area of the Region is approximately 700,000 square miles, which is more than nine-tenths the size of Mexico.

Region C, the Forest and Clearings Belt, contains not only the zone of extensive man-made clearings within the broad-forested areas in European USSR, but it also includes on the south the band of alternate grass and forest patches called forest-steppe in the USSR and parkland in North America. Topographically the region includes large sections of the hill and wet basin lands west of Moscow and Kiev and extends over the flat-topped, dissected uplands and intervening flattish plains of the Carpathian foreland and central European USSR. Within this Region are three of the great Russian cities, Kiev, Leningrad, and Moscow, all of the important commercial or industrial centers of European USSR except a few in the adjacent Grassland Belt, and two-thirds of the key Slavic population of the entire Soviet Union.

The Forest and Clearings Belt is a vast plain broken only by scattered hilly areas in the northwest (toward the Baltic) and by broad, flat-topped, stream-cut uplands in the southwest and center. None of these elevated areas is rugged, except where bluffs border major streams such as the Volga. Local differences in elevation between upland and intervening flattish plains range from 50 to 700 feet, with most of the differences less than 400 feet. Relief features do not handicap cross-country movement and the broad level areas afford almost unlimited possibilities for the rapid construction of roads and airstrips. Locally on these broad, relatively level areas large and small gullies are obstacles and must be detoured.

Poor drainage is the dominant characteristic of most of the lowlands, and of some of the hill lands northwest of a line from L'vov to Kiev to Shcherbakov. The remainder of the Forest and Clearings Belt, with the exception of a strip along the Oka and Middle Volga, is well drained. Most of the large rivers, the Daugava Zapadnaya Dvina, Niemen (Neman, Nemunas), Dnepr, and Volga are navigable, and their headwaters have been connected by canals cut through the low, hilly divides. The navigation season on these streams is limited by winter ice and spring floods and lasts only five to six months, from April or May to October or November.

Soils of the Forest and Clearings Belt vary from loose loams and sands in the south and east to heavy clays, muck, and coarse gravels near the Baltic. Even the heavy, wet clay soils are trafficable for heavy vehicles most of the time after the spring mud has dried and before the irregular autumn rains. From late June to early October, heavy showers may reduce trafficability for a few days. After the period of autumn rains most of the soils are frozen hard and firm from late December to April, when the spring thaws start. Some bog soils and forest soils with thick moss or snow cover do not freeze deeply, even in midwinter, and will support men and light equipment only. During the period of spring thaw and rains (April through June) the clay, bog, and many loam soils are nontrafficable even for tracked vehicles, and men and horses have difficulty in passing over the deeper mud areas. This belt of deep mud follows the belt of spring thaw northward across the Region as is shown on the Trafficability of Surface Materials maps (PLANS 6 to 9).

Vegetation in Region C is a succession of forest with clearings, and this alternation, which is of such importance to military operations, gives the Region its unity and name (FIGURE II-43). On the north margin of the Forest and Clearings Belt, coniferous trees, such as pine, fir, and spruce, are dominant. In the central and southern sections of the region, oak, beech, maple, poplar, and other deciduous trees mix with the conifers, and in the extreme south, eventually replace them. The clearings in the forests of the central and northern parts of the Region are of two types, man-made and natural marshland (FIGURE II-43). The man-made clearings generally are less than a mile across and are occupied by meadows and crops, chiefly small grains, flax, and vegetables. Some of the marshlands are used as pasture and meadow; most are unused. Along the southern border of the region natural openings in the form of strips of natural grassland now are largely planted to crops of sugar beets and small grains. Farther south groves of poplar and willow, between the grass strips, become smaller and more widely spaced until the grasslands are dominant. This is the boundary zone with Region E, Grassland Belt.

The Forest and Clearings Belt is characterized by, 1) the presence of forest areas, 2) the extensive bogs in the northwestern lowlands and the spring and autumn deep mud in all areas, 3) the freezing of streams and most bogs each winter with the resulting decreased speed of excavation and construction, 4) existence of slightly higher, natural areas and routes through wet forest land, and 5) locally large, very deep gullies, as well as smaller shallow gullies cut into pastures and cultivated fields, visible to horizontal view only at close range.

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FIGURE II-43. *Forest and clearings in lowland area north of Polotsk in the Daugava (Zapadnaya Dvina) drainage basin.* Alternate clearing and swamp forest. The cleared land is on slightly higher ground near the streams. Wet meadows are among the flooded lands between the sharp bends in the stream (note dotted areas along the stream). Margins of the swampy areas in the forest are indicated by the light-colored, irregular streaks in the forest. Low, wet-moorland vegetation forms dark, flattish, oval breaks in the forest, near lower margin. The vertical (north - south) route is a railway. The right-left (east - west) route is a first-class road. October 1943.

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The Forest and Clearings Belt is divided into three subregions: the Baltic - West Russian Hills and Wet Lowlands (C-1), the Southwest Russian Upland (C-2), and the Central Russian Plain (C-3). Each of these subregions is discussed separately.

(2) Subregion C-1, the Baltic - West Russian Hills and Wet Lowlands (PLAN 2)

This subregion lies north of the flat-topped Southwest Russian Upland (C-2) and west of the better-drained, undulating Central Russian Plain (C-3). The Baltic - West Russian Hills and Wet Lowlands subregion is an irregularly shaped area with maximum dimensions of 700 miles north - south and 525 miles east - west. It has a total area of 300,000 square miles, which is approximately equal to the area of Texas and Louisiana combined.

(a) Relief (PLANS 2 and 3).—Dominant relief forms within subregion C-1 are flat-to-slightly-rolling plains separated by chains or blocks of low, rounded hills. Many of the hill groups are knobby but not jagged. Slopes are generally less than 15% and maximum elevations are only 800 to 1,100 feet above sea level. Most of the plains are poorly drained for at least part of the year, and several of them have large lakes near their centers. These flattish, poorly drained lowlands of 50 to 300 feet elevation cover more than half of the subregion. The largest and most significant of these wet lowlands is the Pripyat' (Pripet Marshes) Swamp Zone (C-1e). The more important hill areas are Baltic Hilly Areas (C-1a), Hills of the Piepus - Il'men' Divide (C-1b), South Valdai Hills (C-1c), and the West Russian - Smolensk Ridge (C-1d). The following discussion will treat the groups of lowlands and hills in order from the Baltic coast zone on the northwest to the Pripyat' basin and upper Dnepr (Kiev - Bryansk) lowland on the southeast.

Northwest of a line from Warsaw, Poland, to Moscow, the hills and wet basins of the Baltic - West Russian Hills and Wet Lowlands subregion are arranged in irregular bands which fan out north and northeast from a point near Grodno, where the Warsaw - Moscow line crosses the Polish - Russian border.

The western and middle areas of these hills (C-1a and C-1b) are low, gently rounded ridges with many irregular lakes and occasional knobby areas of quite irregular pattern (FIGURE II-44). Most of the knobby sections have woods on the upper slopes and small lakes or wet moorlands in some of the depressions between the elevations (FIGURE II-45). Average elevation above sea level of the western and central hill areas is 350 to 750 feet, with occasional high points reaching 1,050 feet. Few of the ridges and knobs rise more than 150 to 200 feet above the adjacent valleys. Steep slopes (greater than 20% to 30%) are limited largely to short stretches where major rivers, such as the Neman (Niemen), and the Daugava Zapadnaya Dvina, cut through the hills on their way to the Baltic Sea.

The eastern and southern hilly areas (C-1c and C-1d) are in general similar to those in the north and west, although the eastern and southern hills are broader in many places. They are strung out in a continuous series of ridges cut only by the gorge of the middle Neman south of Kaunas. Lakes and marshes are quite numerous in the knobby parts on the easternmost hill area (C-1c).

Slopes, heights, and shapes of the hills in this subregion are less a barrier to movement than are the lakes and swamps, dense forests, and loose, gravelly soils on the slopes. The elevated, dry, hilly areas, with their wide-

FIGURE II-44. *Hills with forest and clearings to the west of Vil'nyus (Wilno).*
Typical low, rounded hills in west USSR. Here the small clearings are occupied by pastures and wet valley meadows. After heavy rainfall the bottomland is usually flooded for a few hours. A small village crowns the hill in the background.

spread, loose, gravelly soils are suitable sites for main roads and railroad lines, and favor the quick, easy construction of temporary roads and of landing strips. In fact the West Russian Smolensk Ridge (C-1d) is used as an elevated, well-drained, 375-mile-long causeway through the wet lowlands of western USSR. This ridge is followed by the main highway and railway between Warsaw and Moscow and was the approach used by Napoleon in 1812 and Hitler in 1941 as the main pathway of advance upon Moscow. Local high, dry roads use other hilly areas in the subregion, and the main railway from Warsaw to Leningrad follows the Grodno - Vil'nyus - Daugavpils string of hill blocks almost to Peipus Lake (Chudskoye Ozero).

The lowlands of the Baltic - West Russian Hills and Wet Lowlands subregion are separated by the belts of hills, and form five comparatively distinct areas. On the west, near the Baltic Sea, one string of depressions extends north from Kaunas, near the Polish boundary, along the shores past the border of the Gulf of Riga and on to Tallinn on the Gulf of Finland. This group of shallow, flattish basins between the hills is partially drained, and it forms the agricultural cores of the former Baltic States, Lithuania, Latvia, and Estonia (FIGURE II-46). On their western and northern margins these lowlands reach the sea in the form of generally low, flat, sandy coasts with many areas of dunes and offshore bars. Only in the extreme north, along the Gulf of Finland, are most of the coasts steep. In the northern part of the subregion, the second and third areas of lowland form a double line of small plains which run northward from Vitebsk along the Peipus Lake (Chudskoye Ozero) and Ozero Il'men' depressions, respectively. The remaining two lowlands in the subregion are comparatively large river basins, namely, the Kalinin Basin along the upper Volga north of Moscow, and the upper Dnepr drainage areas (including the Poles'ye (Pripet Marshes) above Kiev.

All of the lowlands in subregion C-1 are flattish to very gently rolling and are poorly drained. Details concerning the swamps and marshes in these lowlands are given under (b), Drainage. It should be noted here, however, that the presence of wet lands in these lowlands has not prevented their use as main routes, especially in areas where long, round-topped ridges (like the West Russian - Smolensk Ridge) are not available. Railways and roads cross all the lowlands, but such routes are fewer in the extremely swampy areas such as the Pripyat' (Pripet Marshes) Swamp Zone. There the routes are channelized along isolated hill groups, low sand-gravel ridges 20 to 50 feet high, and other slightly elevated areas which rise above the bogs. Agriculture is also carried on in all the lowlands but is localized on the higher, drier areas (FIGURE

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FIGURE II-45. *Area east of Opochka.*
Knobby-type hill lands with forest on the upper slopes, farms and villages on the lower slopes and saddles. Small lakes and moors in a few of the larger depressions. Note the three small oval lakes (black spots) and larger, flattish moorland areas (medium gray) near the lower margin of the view. The road and village patterns are more irregular among these hills than in the adjacent flat lowland areas. Probably 1943.

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FIGURE II-46. *Summer view of Central Lithuanian Plain north of Kaunas.*
Dryland type of plain in the Baltic area. The low but well-drained valley plain at left slopes gently upward to the rolling plain at right and in background. Such well-drained lowlands are cleared and cultivated intensively. Even here scattered patches of woodland offer some concealment. Before 1941.

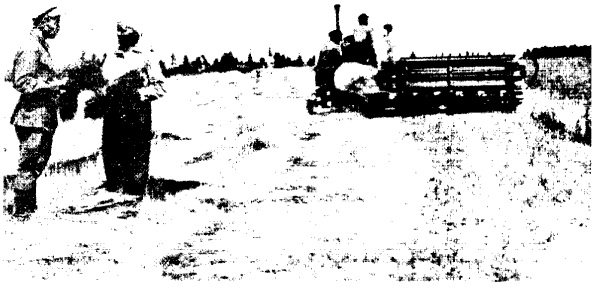

FIGURE II-47. *Harvesting in White Russia.*
Flax harvest on the slightly elevated, but nearly level fields in the lowlands south of Minsk. These fields have been cleared of forest. Remnants of the woods are seen in the background. Before 1943.

II-47). These elevated dry areas with their easily worked sandy soils are the best sites for the quick construction of roads and landing fields.

(b) Drainage (PLAN 4).—The poorly drained lands of the Baltic - West Russian Hills and Wet Lowlands subregion are of two general types: 1) temporarily flooded or saturated lands which dry out and become firm late in summer, and 2) the more widespread moors, marshes, and swamps, which are always saturated or flooded and are soft and yielding except when frozen hard. The moor areas contain thick, spongy, water-saturated masses of grass, reeds, and shrubs with scattered areas of trees on slight elevations (FIGURE II-48). Moors generally fill old lake beds and other poorly drained depressions, and are largest and best developed in the lowlands of the subregion. Moors and small lakes are found in the irregular, knobby sections of the hill lands. Marshes and swamps are distinguished in this report according to the predominance of grass and reeds in the former, and trees in the latter. They frequently are found in stream flood plains. Both marshes and swamps are covered with water or ice most of the year and never become completely dry or firm. They are distributed throughout the western and northern lowlands of the subregion and cover the major part of the Pripyat' (Pripet Marshes) Swamp in the southeast.

In areas such as the small plain south of the Gulf of Riga and the upper Dnepr plain between Gomel' and Bryansk, the lowlands are largely the temporarily flooded type. These lowlands, together with many small marshes and swamps, extend in narrow strips along the streams.

FIGURE II-48. *Large moor south of Grodno.*
The common elements of a moor landscape in the Baltic area are here shown. Small pools of sluggish water, and broad expanses of grass, reeds, and shrubs overlooked by scattered thickets of small trees and brush. The low grass and reed areas are water soaked and impassable except when frozen hard (late December to mid-March). Thin forest on the low ridge in the background marks the far edge of the moor. Before 1941.

Between these streams are slightly higher and better-drained areas within which movement and deployment are possible.

The presence of saturated areas near the streams channelizes movement within the drier interstream areas and limits stream crossings to points where spurs of high ground approach the streams. This situation is modified by the partial drying out of the ground in late summer, August to October, when crossings may be made at many additional points. A similar lessening of the barrier effect comes with the freezing of the wet lands and streams in midwinter, from December to late March. During this period the hard-frozen ground and streams may be crossed in many places by men and light vehicles. Heavy wheeled traffic and the heaviest tanks, however, were unable to move freely across all swamps and marshes in the Leningrad area during the relatively mild winters of 1942-43 and 1943-44. Such heavy equipment broke through the frozen crust into the boggy ooze below. The spots, where the thinly frozen surface gave way, were located in brush- and reed-covered areas which had become deeply drifted from early fall snows.

The wettest lowlands in this subregion (the basins of the Pripyat' river, Ozero Il'men' and Peipus Lake (Chudskoye Ozero) have drainage conditions similar to those in the intermittently flooded areas, but in these wetter basins the problems of poor drainage are intensified (FIGURE II-49). Within these basins the strips of marsh and swamp along the streams are wider and more numerous. Even

FIGURE II-49. *Marshland along the shore of Ozero Chudskoye (Peipus).*
Marsh grass growth is here less continuous than in some wet lowlands. Such areas are nontrafficable and largely impassable except when firmly frozen. Before 1941.

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FIGURE II-50. *Valley of the Zapadnaya Dvina west of Polotsk.*
Here a low swell is cut by the Daugava (Zapadnaya Dvina) and its tributaries to depths of 50 or more feet. Flat peat moors form openings in the woods (upper right) and much of the woodland is swampy. The rolling nature of the terrain is shown more distinctly in the cultivated clearings along the Daugava (Zapadnaya Dvina) (center) and the large tributary (upper left of view). The Daugava (Zapadnaya Dvina) is 500 to 550 feet wide in this view. Probably 1943.

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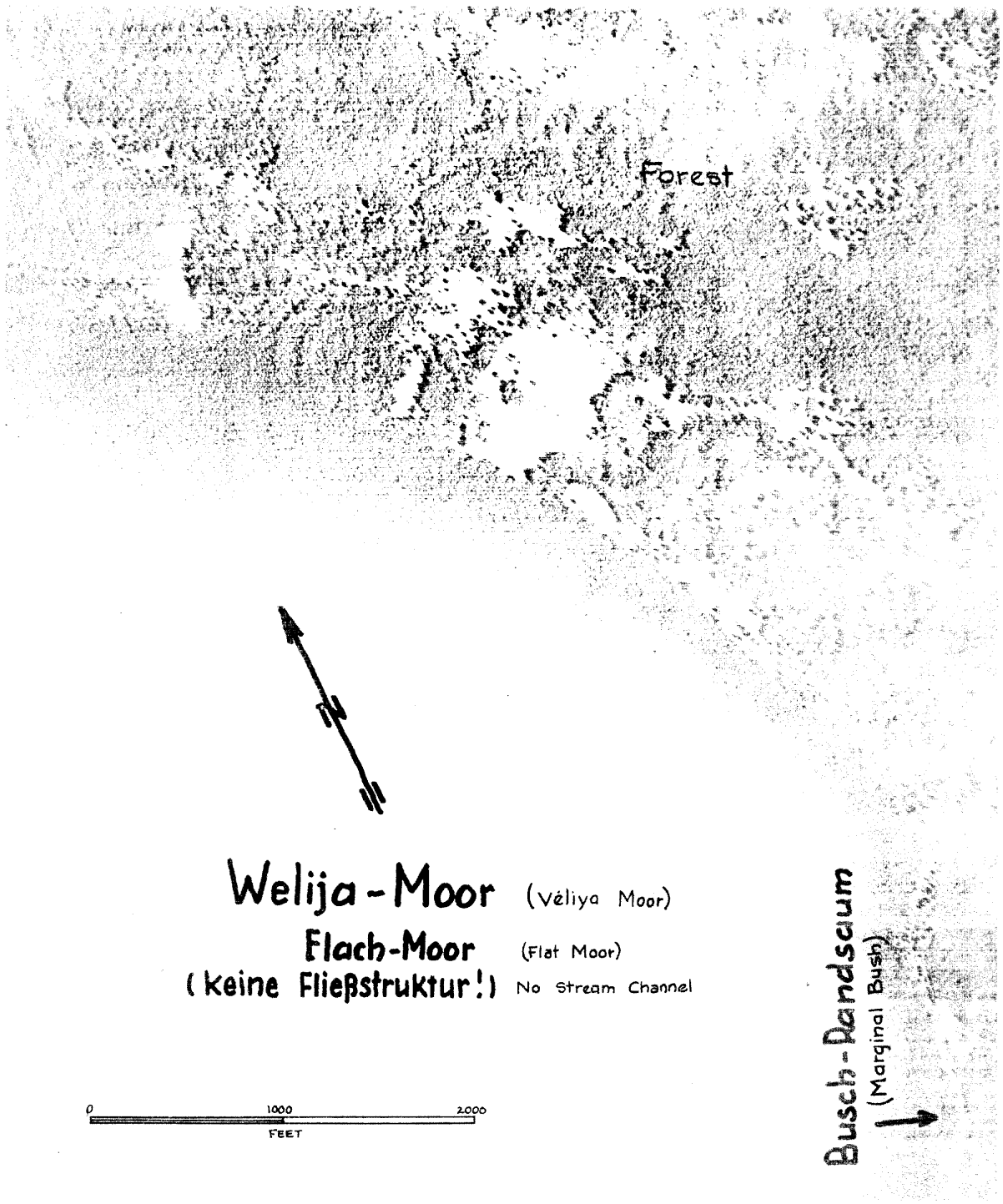

FIGURE II-51. *Wet terrain south of Volkhov.*
The large flat shrub- and bush-covered moor at lower left of the picture is waterlogged; it is nontrafficable and generally impassable except when frozen hard (late December to early March). Even then, heavy equipment might break through the frozen crust. Low sand ridges, in the right and upper part of the view, are dry, and are sites of the local trails (white line) through the wet Il'men'-Volkhov lowland. March 1943.

small tributary streams are bordered by extensive swampy belts, although some streams have narrow bands of slightly elevated dry lands along their banks (FIGURE II-50). In the most poorly drained zones of the Pripyat' and Il'men' depressions the swamps along stream belts enlarge until they merge across the low, flat interstream divides into a continuous swamp-marsh land. These marsh, moor, and swamp areas of the Pripyat' and Ozero Il'men' are scores of square miles in area (FIGURE II-51). They are broken only by a few well-drained sand and gravel swells (FIGURE

FIGURE II-52. *Dry sandy land near the Pripyat' river.* This slightly elevated sandy area is a dry island among the great Pripyat' swamps and marshes. The scattered scrub trees are smaller than those on other sandy areas. Note the wide roadway in which the trail is shifted frequently. Before 1941.

II-52), which rise high enough to be called hills in a few places. Average elevations are 20 to 50 feet above the surrounding wet lands. No large, continuous blocks of dry land exist within the Pripyat' and Il'men' basins. Also, there is very little drying out of the low areas in late summer. As a result, the usual July-to-October period of drier ground common to the subregion and increased possibilities of movement do not occur within these two large, wet lowlands. However, these two areas are frozen over during the same seasons (December to April) as the less wet lowlands, and are subject to the same hazards of thinly frozen surfaces under early formed snow drifts. Also, many of the moss-covered swamps in the lowlands are self-insulating, in that the moss layer adds to the heat-retaining qualities of the snow blanket.

Streams and lakes of the Baltic - West Russian Hills and Wet Lowlands subregion are barriers to movement. Only the largest water bodies, such as the Niemen (Neman) and Daugava (Zapadnaya Dvina) rivers and Lake Peipus (Chudskoye Ozero) and Ozero Il'men', are navigable. The use of these waterways is limited, moreover, by stretches of shallow channel, which are 4 to 6 feet deep in the rivers and 7 to 20 feet deep in the lakes. Only flat-bottomed, river-type boats are used on the navigable stretches of these rivers and lakes. However, during the spring floods (April and May) much timber is floated down the shallow upper stretches of the Niemen (Neman) and Zapadnaya Dvina, and many of the smaller streams.

The many strips of swamp and marshland along stream flood plains are even greater barriers to movement than streams (FIGURE II-54). For example, at many points along the Daugava (Zapadnaya Dvina), the largest stream lying entirely within the subregion, swampy strips along the stream are two to three times the width of the stream, which in its lower course is only about 1,200 to 2,000 feet wide. Its maximum depth is from 25 to 35 feet during summer water levels Where the Daugava can be approached across the poorly drained lands it has a firm sandy bottom which favors fording and bridging.

The main handicaps to stream fording or bridging in subregion C-1 are the periods of spring floods which, during their early stages, bring down much floating ice. These flood periods last roughly two to three weeks. Floods begin early in March near Kiev in the south and end late in April in the northern part of subregion C-1 (FIGURE II-53). During this flood season, lakes in the subregion also reach their maximum volume Shallow Ozero Il'men', for example, overflows during April and becomes three times its average size. These floodwaters from the lake flow off through the river Volkhov and keep it in flood through May and early June (FIGURE II-55).

FIGURE II-53. *Flooded road in the Central Pripyat' area.* Sheets of snow-melt water, such as the one shown in the view, block most of the roads in the Pripyat' basin during late March and April. Before 1939.

FIGURE II-54. *Moors, forest, and crop areas south of Pripyat' river.*
Slightly elevated and better drained portions of the Pripyat' basin are usually cleared and cultivated. Forests indicate lower and more moist areas, whereas the large treeless moors, such as that in the upper portion of the view, indicate continuously saturated soil. Movement through areas such as those shown in the view is difficult, but local movements are possible on the islands of crop land. Note the village along the road (left center) and the more scattered farmsteads (lower right). 1942.

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FIGURE II-55. *Volkhov valley north of Novgorod.*
Looking north. In the foreground is a broad band of flooded forest, portions of which probably are wet even in dry weather. Farther back, the Volkhov has inundated the adjacent sloughs and part of the farm land on the far bank. In the background, clearings in farms and woods alternate with small moors. May 1943.

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FIGURE II-56. *Ice on Neva river at Leningrad.*
Looking northeast. The light railways are easily supported on the thick midwinter ice. Note that no load-distributing mat is used on the ice to support the combined weight of cars and their loads and tracks. In the background is the old fortress of St. Peter and St. Paul on an island in the Neva. Before 1941.

In midwinter the streams and lakes are frozen over hard and firm and their barrier effect is thus eliminated (FIGURE II-56). This period of ice-covered streams lasts from late November to late March in the southern (Kiev) area, and from late November to late April in the northern (Leningrad) district. The modifying effect of relatively warm winds from the Baltic Sea prevents earlier freezing in the northern part of the subregion.

(c) Vegetation (PLAN 5).—Main forest vegetation types in the Baltic - West Russian Hills and Wet Lowlands are dense coniferous forests in the north (near Leningrad) and mixed coniferous and broadleaf forests in the center and west from Kalinin to the Baltic Sea. Chief species of trees in these forests are: 1) pine (on sandy lands), spruce, fir, in the northern forest zone, and birch and alder in small areas (FIGURE II-57); and 2) pine, oak, beech, fir, birch, and alder in the mixed forest belt (FIGURE II-58).

FIGURE II-57. *Spruce forest in the Valdai Hills area northwest of Kalinin.*
This dense stand of large trees, with a typical unpaved road in center of view, indicates the large supplies of timber and firewood readily available and the ease of finding cover and concealment there. Movement of vehicles, including tanks, is largely confined to roads of the type shown. Before 1927.

All of the forest areas of subregion C-1 are interrupted by either natural or man-made clearings. The natural clearings or openings, exclusive of lakes and streams, are occupied by marshes or moors with thin reeds, grasses, bushes, and other low-growing plants. The man-made clearings are devoted to crops, meadow, and settlements (FIGURE II-59). Chief crops in these clearings are barley, flax, rye, oats, field turnips, potatoes, forage grasses, and other low-growing annuals.

Forests occupy 50% to 70% of the land in most of the hilly areas of the subregion. Although clearings are no-

FIGURE II-58. *Dense forest west of Vil'nyus (Wilno).*
This untouched forest of mixed coniferous and broadleaf trees occupies part of the Baltic Hilly Areas (C-1a). Here timber is larger and the stand denser than in the forests farther north. Much of the hill area is more rolling and more difficult to traverse with heavy equipment than the portions shown here. Before 1941.

FIGURE II-59. *Cleared hill lands southwest of Vil'nyus (Wilno).*
Only remnants of the original forest are scattered among the fields, here lying fallow, on the typical gently rolling hills of the Baltic area. Note the relatively dense stand of trees in the hollow in the left background. Before 1941.

where more than a few miles apart, exceptions to this high percentage of forest cover are found in the South Valdai Hills (C-1c) and the Baltic Hilly Areas (C-1a). These uplands are less than 50% forested and have at least 30% of the land cleared and in farms. The remaining upland area is moor or marsh.

The better-drained plains, located in the Baltic Hilly Areas and in the Dnepr basin northeast of Kiev, are only 10% to 40% forested, 20% to 30% wet lands, and as much as 30% to 40% in farms. Poorly drained lowlands such as the Pripyat' and Ozero Il'men' basins have 50% to 60% forest, 20% to 30% marsh and moor, and only 10% to 20% in farms. In all of these areas the actual settlements, mostly small farm villages, occupy less than 2% of the land. They are included with the farms in the figures given above.

The common pattern of vegetation distribution in the Baltic - West Russian Hills and Wet Lowlands subregion is a series of openings occupied by crops or low moor and marsh growth and surrounded by woods or dense forest. The woodland may be open enough for free movement of tanks and other tracked equipment; but the extensive, heavy forest is a thick mass of trees, brush, and fallen timber, difficult to penetrate except along roads and trails. Much of the forest and woodland is swampy

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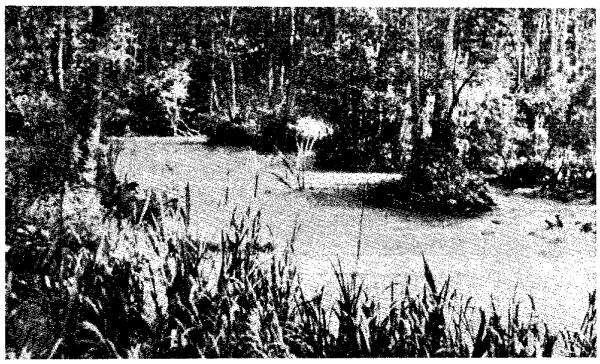

FIGURE II-60. *Swamp in Pripyat' basin south of Pinsk.* Characteristic heavy growth of forest with small trees, dense undergrowth, much open water with grass and reeds along the banks. Cover and concealment are good in these woods but cross-country movement is almost impossible. Before 1939.

(FIGURE II-60). In World War II the Soviet commanders took full advantage of their superior knowledge of the swamps and forests of Baltic - West Russian Hills and Wet Lowlands. They used local guides and trails unmarked on any map to bring tanks and artillery deep into the densest forest growth.

The vegetation of subregion C-1 furnishes good concealment and fair cover in the forest and woodland areas and only fair concealment and almost no cover in the openings. In natural openings the 5- to 8-foot-tall reeds and brush of the marshes and moors provide more concealment than the 2- to 4-foot grain and root crops in the farmlands. Abundant firewood and timbers up to 10 inches by 20 feet are available in the wooded areas.

Large supplies of forage could be obtained from the growing crops and meadows in summer, but food supplies from the cropland would be available chiefly in late summer and autumn. The "scorched earth" policy used by the Russians during World War II deprived the Germans of this food supply. Also any seized food supplies would have to be withheld from the local population which normally has to import part of its food. Small areas near the Baltic Sea and east of Kiev are exceptions to the foregoing as, in some years, they import no staple foods.

(d) Trafficability of surface materials (PLANS 6 to 10).—Throughout most of the Baltic - West Russian Hills and Wet Lowlands subregion bedrock underlies thick layers of sand and gravel. In the low, poorly drained areas clay and muck overlie the sands. Many of the sandy soils which are marked on the soil trafficability map as draining rapidly are in the nearly flat plains areas and actually are waterlogged. This apparent anomaly results from the fact that the streams have very low gradients and cannot remove the water as fast as it can drain from these loose soils; thus the water table continues high. Poor drainage of soils in flattish lowlands is particularly marked in the western and northern parts of the subregion in the Baltic and Il'men' plains. There the spring melt waters from deep snows are followed by heavy spring and summer rainfall which prolong the period of soil saturation (PLANS 6 and 7).

The predominantly gravel, sand, and sandy loam soils on the slopes of the hilly areas drain quickly and are trafficable except during and shortly after heavy rains. Exceptions to this are the irregular depressions in the knobby parts of the hill lands around Vil'nyus (Wilno, Vilna) and west of Rzhev. These small basins among the rounded, gravel hills are occupied by swamps or moor and are nontrafficable. However, these wetlands are passable by men on foot if local guides are employed and trails are used. Also the moors and lakes within the knobby hill sections can be bypassed along the well-drained slopes of the adjacent knobs and higher terrain between the knobs. As a result, the hill lands of subregion C-1 are generally trafficable and passable, and provide routes of penetration into the country.

Difficulties of cross-country movement and of deployment in the marshes, swamps, and wet meadows of the lowlands in the Baltic area have been explained in detail in the section on Drainage (Topic 22, C, (2), (b)). These excessively wet and nontrafficable lands have soft, boggy, clay, and sandy loam soils. The interstream areas have patches of similar soils but with a preponderance of sand, gravel, and some bouldery soils on the slightly elevated swells and isolated hills (FIGURE II-61). Such sandy and rocky, elevated areas drain rapidly and are trafficable.

FIGURE II-61. *Boulders in a field on Saaremaa island, Estonia.* The large boulders in the field (foreground) and the smaller ones in the stone fences are only the larger rocks in this gravel-boulder soil. Many smaller rocks remain in the ground. Scrub trees are reclaiming the stony pasture in the foreground. Boulders and rock fences, such as those in the view, offer considerable horizontal cover and concealment. Before 1941.

However, these slightly higher areas are only isolated spots or strips surrounded by the soft, wet soils, and are not useful for roads or cross-country routes. Such roads as do exist in the lowlands of the subregion are supported on deep fills or corduroy-brush mats in the numerous boggy areas. Only short stretches of the better roads have the more expensive deep-fill foundation. Most of the roads have a surface of natural soil or thin gravel with corduroy mats over the worst of the soft areas (FIGURES II-62 and II-63). During the fall and winter of 1941-42 in the Leningrad area average roads were quickly torn up by motorized traffic; in many boggy places the corduroy mat support was crushed down into the soft soil and disappeared. Such roads had to be remade almost completely after a few weeks' use. Similar deterioration of roads on the soft soils of the wet lowlands occurred in other parts of subregion C-1.

Trafficability of soil and durability of roads in the subregion varies with the seasons. Conditions described above are largely those of summer and early fall, June to October. During October or early November heavy rains over a period of one to three weeks create a short season of deep mud and bottomless roads. This was the season in which the roads were cut to pieces around Leningrad in the campaign of 1941-42. During late November and early December sudden, sharp drops in tempera-

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FIGURE II-62. *Road through forest in lowland near Minsk.* Natural earth road through the wet but not completely swampy forest. Boggy soil areas, such as the one shown, are almost completely nontrafficable except when frozen hard (late December to late March). After 1941.

FIGURE II-63. *Road in lowland east of Leningrad.* Typical corduroy road across a marsh. Note the narrowness of the road and the open water at the left. Before 1941.

ture following heavy rains may solidify deeply rutted roads into almost nontrafficable masses of frozen ruts and ridges. Such roads tore tires off trucks and treads off tanks in World War II.

By late December all roads, exposed soils, and streams are frozen hard. However, as explained in the section on Drainage (Topic 22, C, (2), (b)), boggy areas with a thick moss or deep snow cover formed early in the season may freeze thinly and later give way under heavy equipment. Brush mats on roads in boggy areas produce the same insulating effects; consequently the ordinary roads in the subregion were classified by the Germans as nontrafficable for heavy tanks. An additional winter traffic hazard in the subregion is the deep snow of midwinter (December to March). Snow must be cleared frequently from the narrow roads cut through the forest, or deep drifts will block all wheeled and tracked vehicles, except special wide-tracked snowmobiles.

Spring thaws and rains cause deep, muddy surfaces throughout the lowlands of subregion C-1. The mud season begins in mid-March in the southern district (Kiev) and lasts as late as mid-April in the northern section (Leningrad) (PLAN 6). Deep mud, which stops all cross-country movement and traffic on most roads, lasts three to four weeks in any given locality. This is followed as a rule by another period (two weeks) of gradually drying surfaces and slowly improving trafficability. The coarse, better-drained soils in the hilly areas of the subregion remain relatively dry, firm and trafficable during the spring thaws. Boggy soils in the patches of moor on the hills become soft in the spring but are easily bypassed via the surrounding sand and gravel knobs and ridges.

In summary, the hilly areas of subregion C-1 generally are passable for men and trafficable for vehicles at all seasons; but the lowlands are passable, and for the most part trafficable only in midwinter. During other seasons the lowlands are fairly passable and trafficable in late summer, but they are nontrafficable and almost impassable during the spring thaw season and during the fall rain and freeze season.

(3) Subregion C-2, Southwest Russian Upland (PLAN 2)

The Southwest Russian Upland is a series of low, partially dissected plateaus of 600 to 1,300 feet elevation above sea level. The upland extends northeast from the Ukrainian Carpathian Mountains (Region D) and the river Prut as far as the Pripyat' (Pripet Marshes) Swamp Zone (C-1e) and the Dnepr (PLAN 2). On the west the upland extends beyond the JANIS 40 border. This subregion is roughly quadrangular in shape and is oriented slightly northwest to southeast, with its long axis parallel to the Carpathian Mountains. The long northwest - southeast axis measures about 350 miles and transverse dimensions vary from 200 to 250 miles. The area of the subregion is about 60,000 square miles, which is approximately equal to that of the State of Georgia.

The Southwest Russian Upland is the westernmost of a series of alternating low, dissected plateaus and still lower and flatter plains (C-2 and C-3) which occupy the southern and eastern parts of the Forest and Clearings Belt (Region C). This western upland is considered as a separate subregion chiefly because its surface is more or less level and is not cut up into small fragments on flat-topped hills, as is that of the uplands farther east in parts of the Central Russian Plain, subregion C-3.

Another reason for treating the Southwest Russian Upland as a separate subregion is its function as an east - west route extending between the swamps and marshes of the Pripyat' basin on the north and the rugged, forested Ukrainian Carpathian Mountains on the south. This dry, relatively flat-topped area south of the Pripyat' Swamp Zone extends eastward to Kiev, just as the Smolensk ridges form a raised east - west route north of the Pripyat', extending eastward to Moscow. The Southwest Russian Upland has been used as a route of advance on Kiev and South Central USSR (the Ukraine) from the earliest times to and including World War II. Several passes in these mountains give access to the Hungarian plain and middle Danube basin.

The city of L'vov occupies the most strategic point within the Southwest Russian Upland. This city is located at the westernmost and narrowest part of the subregion where the main east - west routes pass into and out of it. L'vov also is far enough west to control key railways which extend northwest to Warsaw and central Poland and southward to the Carpathian passes and Hungary. In addition, L'vov is on the main railway which runs from the USSR along the northeastern foot of the Carpathians into eastern Rumania.

(a) Relief (PLANS 2 and 3).—The Southwest Russian Upland is composed of a series of broad northwest - southeast trending plateau blocks marked off by the deeply incised valleys of the Prut, Dnestr, Yuzhnyy Bug, and Dnepr. Each block, with one exception, reaches its maximum ele-

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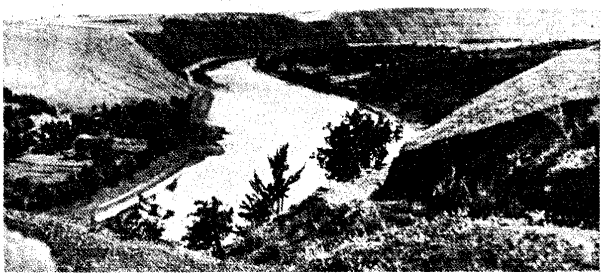

FIGURE II-64. *Entrenched valley of the Dnestr east of Stanislav.* Even near its headwater, the Dnestr has cut several score feet below the flat plateau, as can be judged from the size of the houses among the trees in the left middleground. Note that woodland is limited to the valley bottom and lower slopes. Before 1941.

vation (900 to 1,300 feet) along its northwestern margin, and slopes gently south - southeastward to the next marginal river gorge, which is 100 to 450 feet below the adjacent plateau (FIGURE II-64). The northernmost of these plateau blocks lies north of a line from Przemy'sl through L'vov to Zhitomir. Northward the surface declines and gradually reaches the level of the low, marshy plain of the Pripyat' Swamp Zone (FIGURE II-65).

FIGURE II-65. *A flat, barren, sandy area north of Zhitomir.* Exact location not determined. This sandy area is in the border zone between the Southwest Russian Uplands and the Pripyat' Swamp Zone. This area has less forest than most of the border area. The wide roadway is typical. Before 1941.

A similar gradual decline in elevation marks the southeastern boundary of the subregion from Kishinëv (Chisinău) to Cherkassy, although the final merging of the plateau with the Black Sea plain on the south lies within the Grassland Belt (Region E). Both the northern—Pripyat' (Pripet Marshes) Swamp Zone—and the southern (Grassland Belt) margins of the plateau blocks are series of projecting, partially forested ridges interfingered with wide, flat valley extensions of the adjacent lowlands (FIGURE II-66). On the south the outermost low ridges of the plateau are completely grass-covered and are placed, therefore, within the Grassland Belt (Region E).

The incised valleys of the major streams—Prut, Dnestr, Yuzhnyy Bug, and Dnepr—and their main tributaries form a series of deep grooves in the monotonous, nearly level surfaces of the plateaus of the Southwest Russian Upland (FIGURE II-67). These valleys are considerable barriers to any cross-country movement, due to their depth of 100 to 450 feet, steep walls, and wet, marshy floors. The valleys tributary to the Pripyat' system on the north are shallower and wider but have larger marsh strips than those of the four above-named streams, and also are considerable impediments to movement (FIGURE II-68). A narrow,

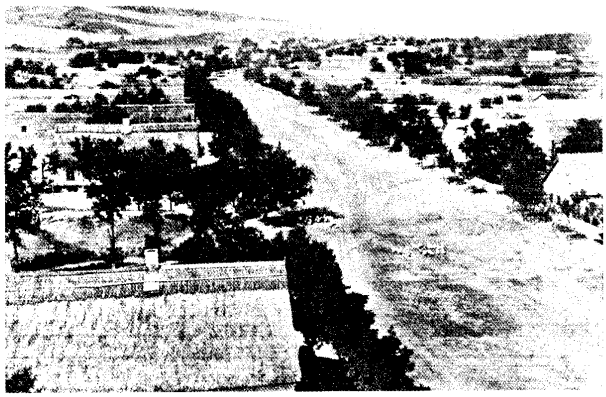

FIGURE II-66. *Broad valley in the southern border of the Southwest Russian Upland.*
The wide, flat valley (right) and gently rounded ridge (left) are largely in crops and grass. Trees in the village are planted. The wide, unpaved, grassy street is typical of those in villages in this area. Before 1941.

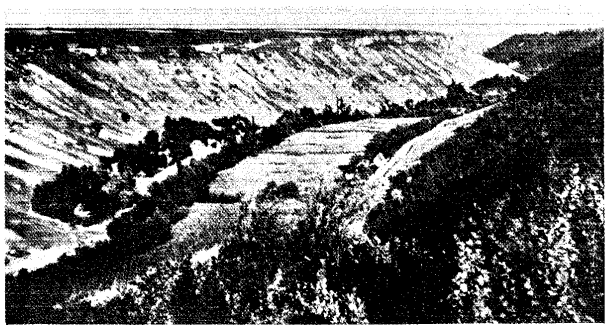

FIGURE II-67. *Valley of the Seret, north tributary of the Dnestr, in the area south of Ternopol'.*
Probably looking north. This deep, steep-sided valley forms a giant trench in the flat plateau. Such valleys are typical of the major north tributaries of the Dnestr in the Southwest Russian Upland. Note the woods on one slope at right, the barren opposite slope, and the cropland and villages in the valley. Before 1941.

FIGURE II-68. *Valley of the Sluch', tributary of the Pripyat', west of Zhitomir.*
North-flowing streams, like the Sluch', do not cut as deeply into the plateau as the south-flowing, Dnestr tributaries. Nevertheless these northern streams and their valleys are considerable barriers to movement. Note that the Sluch' valley shown here, has lower and more gently sloping sides, some parts of which are cultivated. Also note the greater amount of woodland on the plateau surface (left background). Before 1941.

nearly level watershed belt extends east from L'vov past Ternopol' and Proskurov to Kiev.

In addition to the deep-cut valleys, several minor types of irregularities break the surfaces of the southwestern plateau blocks. These irregularities are: 1) groups of

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FIGURE II-69. *Low rounded limestone hills on the southern portion of the upland.*
View of area a few miles southeast of Ternopol'. These hills rise about 130 feet above the flat treeless surface of the plateau. Scattered scrub woodland (left background) occupies part of the rounded summit areas of the hills. Such hills are only slight barriers to cross-country movement in spite of scattered limestone ledges. Before 1941.

round-topped hills, 40 to 150 feet high, which trend north - south across the subregion in a narrow zone east of Ternopol' (FIGURE II-69); 2) narrow, steep-walled gullies 20- to 50-feet deep throughout the subregion, and particularly numerous between the Dnestr and the Yuzhnyy Bug (FIGURE II-70); 3) small hollows or sinks a few yards in diameter and 6 to 20 feet deep. The hills and gullies offer some obstruction to rapid maneuvering of vehicles. Plateaus on the low hills also make excellent observation points. The plateaus as a whole, with their numerous broad, flat, well-drained surfaces, now largely cleared of trees, offer almost limitless opportunities for emergency landings and for the rapid construction of landing strips. However, branching gullies locally dissect these uplands, particularly along the Dnepr (FIGURE II-70).

(b) Drainage (PLAN 4).—The basic drainage pattern of the Southwest Russian Upland already has been outlined under the discussion of plateau blocks and valleys. The major streams within the subregion—the Prut, Dnestr, and Yuzhnyy Bug—are navigable for small boats in their lower courses, i.e., toward the southeastern boundary of the subregion. These streams and their marshy valleys are large enough to obstruct cross-country movement in some degree. For example, at average summer water level, the Dnestr is 250 to 800 feet broad and 7 to 18 feet deep along most of its course through the subregion. The Prut and Yuzhnyy Bug are slightly smaller. These streams average only 150 to 400 feet in breadth and 4 to 16 feet in depth. Their steep-walled, marshy-floored valleys are greater barriers than the actual streams.

The largest stream in the Southwest Russian Upland is the Dnepr, which forms the eastern boundary of the subregion. Immediately south of Kiev this large stream is 1,300 to 2,400 feet broad and averages 10 to 25 feet deep. The Dnepr is navigable for flat-bottomed river boats throughout the stretch which borders subregion C-2. The Dnepr, together with the wide, partially marshy flood plains on its east banks and the high bluffs on its west banks, is a considerable obstacle to east - west movement (FIGURES II-71 and II-72). Poorly drained valley floors also form important barriers along the northern streams

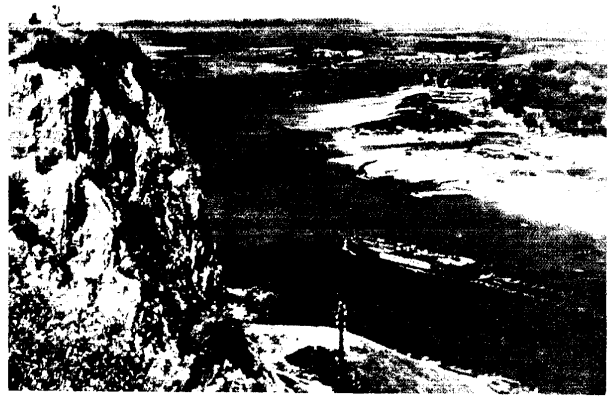

FIGURE II-71. *View of Dnepr river.*
Below Kiev, exact location not determined. Looking toward the northeast. The contrast between the high-bluffed west (right) bank and the low flat east (left) bank is apparent. In the background is the gently rolling upper Dnepr Plain east of Kiev. One of the larger river steamers is shown in the channel. Before 1941.

FIGURE II-70. *Head of a typical gully in the deep loam soils of the upland.*
Near Kiev. Steep earth walls of these gullies crumble easily and erode rapidly. Note the predominant grass cover of the plateau surface in the view and the few trees in the village shown in the background. Before 1941.

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FIGURE II-72. *Upper Dnepr, north of Kiev.*
The Dnepr with its wide lowland containing numerous channels is a barrier to movement at all times except when firmly frozen in winter. Settlements lie on higher, better-drained portions or on upland surface. The high-bluffed west bank, which marks the eastern margin of the Southwest Russian Upland (subregion C-2), shows clearly at the right center of the view. 1943.

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tributary to the Pripyat'. These small streams are only 150 to 350 feet wide and 3 to 12 feet deep at average levels.

Drinking water in the subregion is available in large quantities only near the bottoms of the deeper valleys and of the tributary valleys. By late summer the water table in many places is 100 to 150 feet below the surface of the main plateau blocks. As a result of this occurrence of potable water, most of the farm villages are located near the base of the valley slopes (FIGURE II-73).

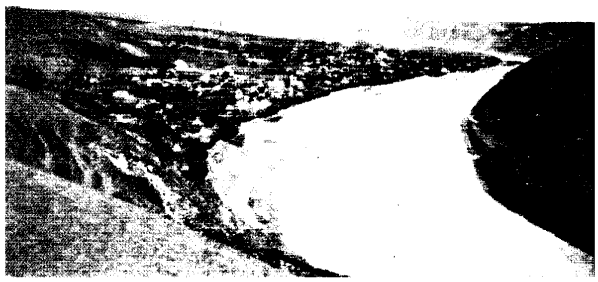

FIGURE II-73. *Valley of the Dnestr at Zaleshchiki.*
Village on the gently sloping valley floor located so as to obtain water from the stream or shallow wells. Note the even horizon formed by the level surface of the plateau. Before 1935.

The Prut and the Dnestr receive much snow-melt water from the Carpathians and thus experience a second flood season in late June and early July. The first flood of the year comes in April or May, is common to all streams in the subregion, and lasts for 10 to 15 days. During the June-July high water the flooded area in these valleys may be half a mile to a mile wide, depending on the type and amount of previous precipitation and the width of the valley floors.

All of the stream and valley marshes in the subregion are frozen over from late December to late February. During that period the frozen surfaces will support men and light vehicles. Heavy vehicles may break through the ice or frozen crust unless abnormally cold weather has created unusually thick ice.

(c) Vegetation (PLAN 5).—Almost continuous forests of oak, beech, hornbeam, and other broadleaf trees occupy the plateaus and interstream ridges of the northern and northwestern divisions of this subregion. Many of the valleys are in crops. Between L'vov and Cherkassy the upland area is occupied by grass and crops, of which the major ones are wheat, barley, rye, sugar beets, and potatoes. Patches of broadleaf woodland are on the scattered hills and the valley slopes (FIGURE II-74). Much poplar, willow, and low alder appear among the small oaks in the valleys. Farther south, on the clay loam soils between the Dnestr and Prut, the upland flats support much oak-hornbeam forest, the valley slopes are cultivated, and the marshy valley bottoms are occupied by grass and reeds with some willows along the streams.

Only these almost continuous stands of oak and other broadleaf forest on the northern and southern upland surfaces furnish much cover and concealment, but these would be greatly reduced in fall and winter when the trees are bare. In the central crop and grassland area of the Southwest Russian Upland, between L'vov and Kiev, the low vegetation furnishes concealment only from horizontal observation. This central zone has a surplus of forage, wheat, and barley in the autumn, but there is very little firewood or timber. In contrast, the northern and southern forested belts of the subregion have abundant supplies of firewood and timber, but only moderate amounts of surplus grain and forage.

(d) Trafficability of surface materials (PLANS 6 to 10).—Fine, silty loam material covers the plateau blocks and the shallower valleys of the Southwest Russian Upland to a depth of 20 to 50 feet. South of the Dnestr and along the Prut there is much clay loam, with clays and some sands occupying the deeper valley lowlands. Most of these soils quickly become bottomless, almost liquid mud

FIGURE II-74. *Kremenets, a city in a small valley near the northern border of the Upland.*
Location of the city in the valley and the woodland on the valley slopes and on the adjacent plateau surface are typical features of the Southwest Russian Upland. Before 1941.

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during the spring thaw season of late March to early May (PLAN 6). The heavy clay soils in the Dnepr-Prut zone are sticky when wet and are even less trafficable than the silt loams farther north. These silt loams on the plateaus drain rapidly and become fairly dry and firm within two or three days after ordinary rains. In contrast, the heavy clays on the river bottoms dry more slowly, and some areas never become completely dry and firm.

During the summer and autumn, from June to October, the silt loams and most of the clay loams of the subregion are trafficable except for a few hours after the heavy showers which occur throughout this period. During the summer season, clouds of dust rise from these fine-grained soils when they are dry. This dust cloud quickly reveals location of any column moving along a road or across ploughed fields.

In early winter, November and late December, unsurfaced roads quickly become a series of hard ridges and ruts as sharp, freezing weather follows heavy rains. These frozen ruts damaged treads on German tanks in World War II. As winter advances the ground freezes hard and remains firm until thaws set in during mid-March. Danger of heavy vehicles breaking through the frozen soil crust over the valley bogs has been described (Topic 22, C, (2), (b)).

(4) Subregion C-3, Central Russian Plain (PLAN 2)

The Central Russian Plain is very roughly quadrangular in shape with its long axis oriented east - west. It varies in length from 525 miles on the north to 725 miles on the south, its width varies also, from 435 miles on the west to 375 miles on the east. Total area of the subregion is 340,000 square miles, which is approximately the combined area of Colorado, New Mexico, and Arizona. Differences in relief, drainage, and soil trafficability within the subregion do not overcome the fundamentally unifying factors of low elevation, few steep slopes, cover of alternate forests and clearings, and generally good drainage.

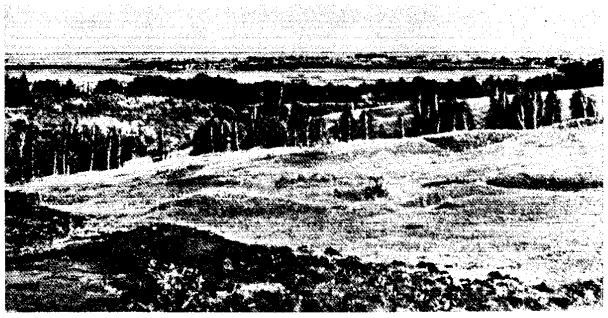

FIGURE II-76. *Upper Don plain, north of Voronezh.*
The more rolling land in the foreground gives way to nearly flat plains in the background. Scattered strips of woodland in the depressions separate the broad grass and crop areas in the background. Before 1941.

(a) Relief (PLANS 2 and 3).—Major relief features of subregion C-3, are a series of low, generally flattish plains alternating with wide belts of slightly elevated hill lands. Huge, deep gullies and many smaller ravines cut the surface of these areas locally.

The plains are of three slightly different types: 1) the wide, very gently rolling, but well-drained, lowlands of the Middle Dnepr Plain (C-3a) and Upper Don Plain (C-3c) (FIGURES II-75 to II-77; 2) the small, flat, incompletely drained basins and gently rounded divides of the Upper

FIGURE II-75. *Middle Dnepr Plain, southeast of Kiev.*
This nearly flat and almost treeless plain is typical of the middle Dnepr area (FIGURE II-92). The wide, unpaved, multitracked road and thatched-roof houses also are typical. Roads and fields such as these are deep in mud after every heavy rain and become completely nontrafficable after the spring snow melt and rainy season. 1925.

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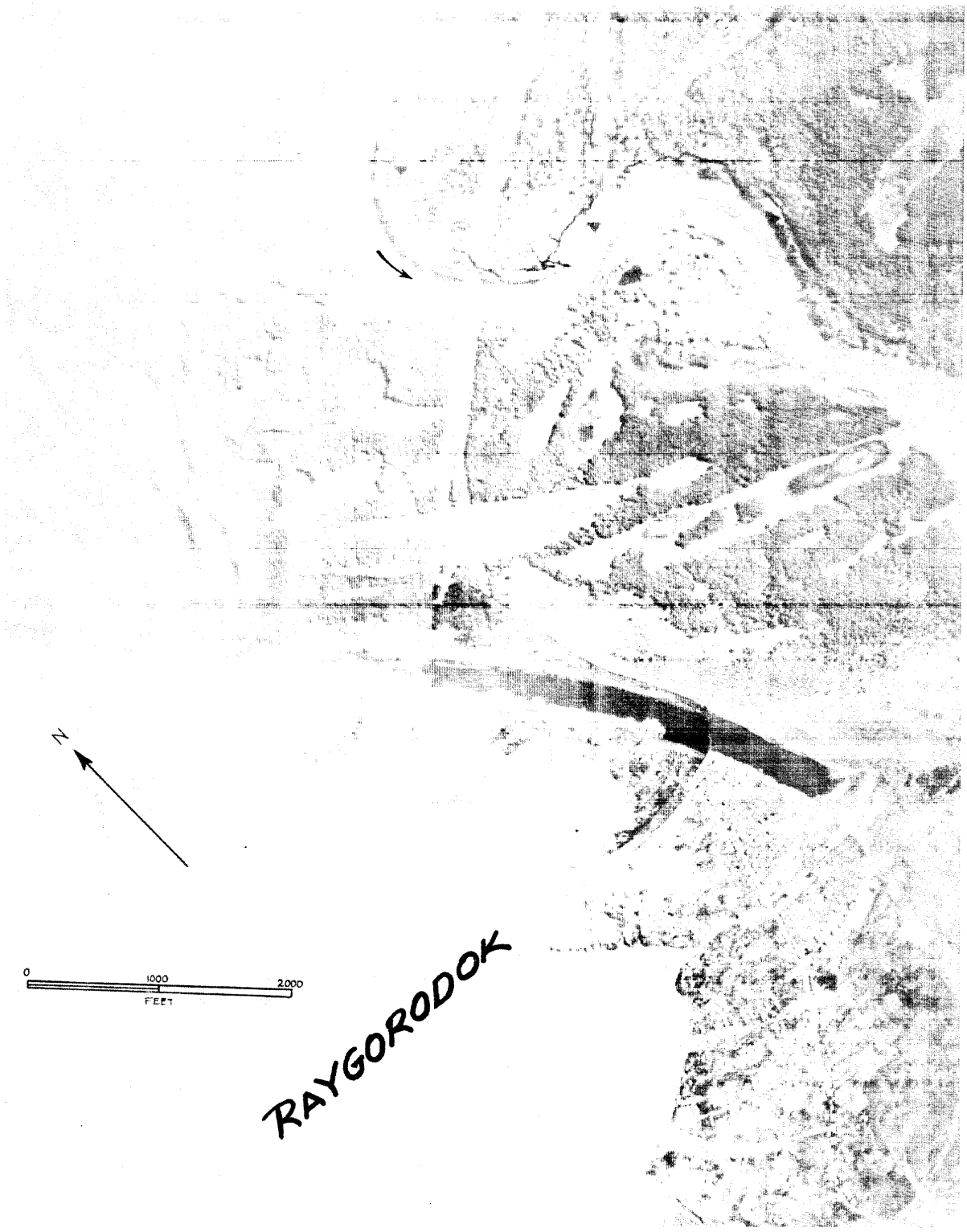

FIGURE II-77. *Upper Donets Valley, northeast of Khar'kov.*
Wooded valley floor (upper part of view) contrasts greatly with the flat treeless crop-covered upland (lower left of view). Wooded lowland furnishes concealment and some cover, but high water table and swampy nature of its floor make it a barrier to movement. Note gullied margin of the upland (left center), gullies and gully heads biting into the level area (lower center) and the village location on higher ground (lower right). July 1943.

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FIGURE II-78. *Low divide, south of the upper Volga near Yaroslavl'.* These low, rolling, elevated areas, locally called "plateaus", are partially cleared and much more easily traversed than the wet lands in the depressions near the streams. Before 1941.

Volga Lowland (C-3e) and the Oka-Vetluga Wet Lowland (C-3d) (FIGURE II-78); 3) the narrow, flattish, seasonally flooded areas of the Middle Volga Flood Plain (C-3g). All of these plains are elevated less than 500 feet above sea level. The only extensive areas within the plains which have slopes with gradients greater than 25% are: 1) short, steep banks along a few of the major streams, 2) scattered sand ridges, 15 to 25 feet high in the Oka-Vetluga Wet Lowlands (C-3d) east of Moscow, and 3) the edges of terraces in the Middle Volga Plain (C-3g). Relief conditions in these plains interfere very little with military operations. The ubiquitous forest areas and the poorly drained stream basins east of Moscow are the main handicaps to movement and deployment within the subregion.

The hilly areas of the Central Russian Plain (C-3) also vary slightly in their relief characteristics. The westernmost hill lands of the subregion, the Central Russian Hills are round-topped in the north and east, but in the southwest, near Bryansk, and Orël, there are some broad, flat-topped ridges (FIGURES II-79 and II-80). Within this hilly area local differences in elevation exceed 100 to 200 feet in few places; and the highest points, which lie east of the center of the area, range from 700 to 900 feet above sea level. The eastern terminal slopes, which overlook the Don plain north of Voronezh, are fairly steep (15° to 30°) and rise 150 to 200 feet within less than a mile. With the exception of these broad scarps there are few steep slopes in the Central Russian Hills. Farms, roads, and railways occupy the gentle hill slopes and flat-to-rounded crests as well as the valleys. Relief factors interfere very little with movement and deployment within these hills. Here, as in the adjacent plains, forest patches on the slopes and small, poorly drained areas in some of the valleys are the chief terrain obstructions. On the western margin of the Central Russian Hills elevations are lower and the hills merge with the undulating upper Dnepr plain west of Bryansk (FIGURE II-81).

The eastern hill lands of the subregion are located on either side of the middle Volga; the Pre-Volga Hills (C-3f) on the west and the Trans-Volga Hills (C-3h) on the east. In each of these upland areas the hills are flat-topped and

FIGURE II-79. *Valley east of Klin in the Central Russian Hills.*
North of Moscow. Broad gently sloping valleys and rounded hills of small elevation, as shown in the view, are typical features of the Central Russian Hills. Most of the valley slopes are in crops or grass; yet even here patches of woodland offer concealment. Note the typical dirt road (left middle ground) leading to the village in the center background. Before 1941.

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FIGURE II-80. *Flat summit type of hills.*
West of Orël. Horizontal visibility is extensive along the flat interstream areas and across the valleys. Sparse scrub trees on the slopes of the shallow valleys offer some concealment. Note how the roads follow both the flat, interstream, cropped areas (lower right) and the grassy or cultivated bottoms of the valleys. Other features in the view are the villages along the road (left center) and the series of entrenchments which extend diagonally from lower left to upper right. August 1943.

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FIGURE II-81. *View in Forest and Clearings Belt about 80 miles northwest of Orël.*
Clearings with crops and a village extend west from the small stream (upper left). Other clearings (center and lower right) are being reclaimed by forest. Note that even the main road (left) is partially obscured by the heavy forest growth or by shadows of the trees. Although the land is not hilly, it has sufficient slope to be free of swamps and moors. The only wet lands are narrow bands of marsh along the streams. These marshes are indicated by the edge of the cultivated fields (upper left). September 1943.

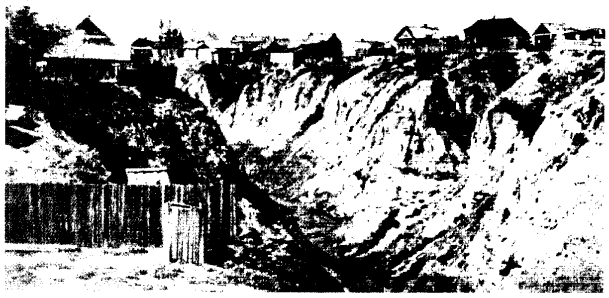

FIGURE II-82. *Large gullies in the Pre-Volga Hills.*
Typical deep, narrow, dry gullies, flooded deeply in spring and after heavy summer rains. Note where buildings are being undermined by the caving sides of the gullies. Before 1941.

the valleys are sharp-cut, steep-sided notches 60 to 400 feet deep (FIGURE II-82). Valley bottoms are generally narrow and winding in both of the Volga Hills areas, although the northern part of the eastern or Trans-Volga Hills (north of Kazan') has many valleys with flat, sandy bottoms; these valleys vary in width from one-eighth to one-quarter of a mile. Within both the Pre-Volga and Trans-Volga Hills, elevations gradually increase toward the east. Highest elevations in the Pre-Volga Hills (1,100 to 1,250 feet) lie within 5 to 25 miles of the Volga. These hills terminate abruptly in bluffs, 300 to 600 feet high, along the west bank of the Volga (FIGURES II-83 and II-84). Eastward, beyond the low flood plain of the Volga, the Trans-Volga Hills rise gradually northeast and east toward the Ural Mountains foreland, which lies outside the area of JANIS 40. Elevations in the Trans-Volga Hills reach only 650 to 850 feet above sea level at the eastern boundary of the JANIS area, although greater elevations are attained farther east.

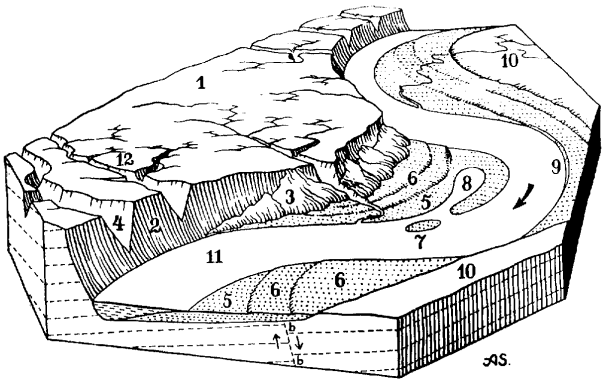

FIGURE II-83. *Diagram of a typical section of the Volga river valley between Kazan' and Kuybyshev.*
View is northwest toward the high right (west) bank. Main elements of the physical landscape at July low water are shown by numbers on the diagram: 1) flattish top of Pre-Volga Hills; 2) bluffs along the high west bank; 3) debris at foot of the bluffs; 4) narrow valleys which separate hill blocks; 5) low terraces (chiefly on left (east) bank) which are flooded in the spring (April-June); 6) higher terraces, usually drier than those close to the river, but which may be flooded during high water; 7), 8) sandbars, islands, and enclosed false channels; 9) steep east bank, found on outside of bends only; 10) higher nonflooded terrace leading up to Trans-Volga Hills (to right of view); 11) main channels of Volga; 12) deep gullies crossing the level areas. (Vertical proportions are greatly exaggerated.)

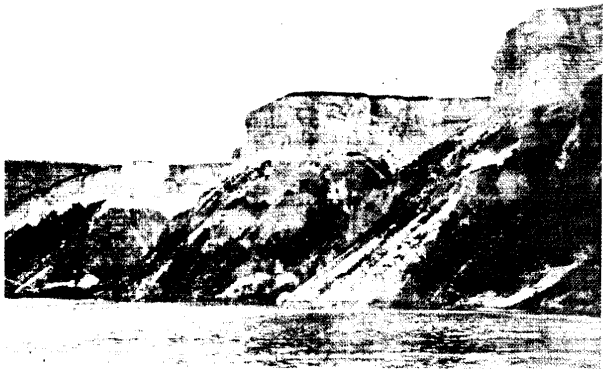

FIGURE II-84. *High bluffs on the right (west) bank of the Volga opposite Kuybyshev.*
These high, solid-rock bluffs topped by vertical cliffs and pierced by narrow-notched side valleys are slightly higher than the average for the lower Volga but otherwise are typical. Before 1941.

Many of the interstream, flat-topped hill blocks, particularly in the Pre-Volga Hills, are several miles across and scores of miles long. As a result, farms, roads, railways, and some villages are located in clearings on tops of the ridges. However, better ground water supply and easier gradients cause many villages and routes to be located within the narrow valleys. Through railways alternately follow valley bottoms and ridge tops, using in each locality the one which is most nearly alined with the direction the route must maintain.

Block ridge-and-valley terrain such as that in the two Volga Hills areas tends to channelize movement along the easily traversed, flat, ridge tops and within the few broad, flat-bottomed valleys. Both V-shaped and broad-bottomed valleys are steep sided, and movement across them is possible but difficult, particularly if the valley soils are soft and slippery from snow-melt or recent rains. Gullies across level areas compel detours. Moderately dense forests on the slopes add to the difficulties of cross-country movement in the Volga Hills areas, but the barrier effect of these woods is secondary to the barriers of relief and of the streams (FIGURE II-85).

(b) Drainage (PLAN 4).—Most parts of the Central Russian Plain are well drained. The only extensive areas of swamp and marsh are: 1) large sections of the Oka-Vetluga Wet Lowlands (C-3d); 2) small stream basins such

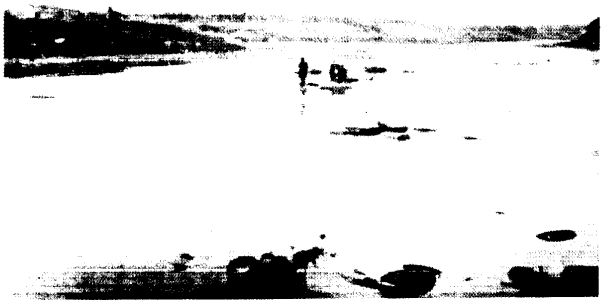

FIGURE II-85. *Lower Kama valley east of Kazan'.*
Although the stream is low at this esason (summer) the broad, main rocky channel, plus steep, partially forested banks, with much loose rock on the slopes, constitute a handicap to movement. Before 1941.

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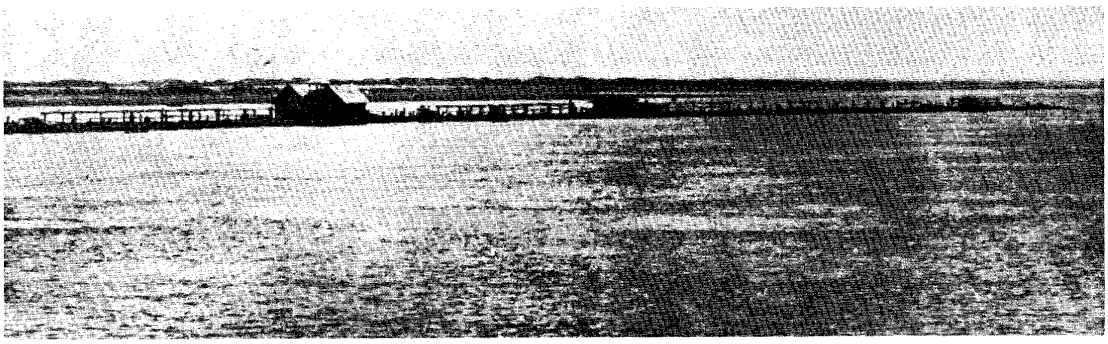

FIGURE II-86. *Volga and its low, east bank.*
The low, east or left bank of the Volga shows in the background beyond the large raft in the channel. These low, largely grass-covered lands are flooded in spring. Note the scattered clumps and strips of woodland on the flood plain. Before 1941.

as the Kostroma in the Upper Volga Lowland (C-3e); 3) a few wide valleys in the Volga Hills areas (C-3f and C-3h) north and south of Kazan'; and 4) the seasonally flooded bottomlands along the Volga below Kazan' (C-3g and FIGURE II-86).

Only the Oka - Vetluga Wet Lowlands (C-3d) and Volga Flood Plain (C-3g) are large and continuous enough to act as barriers to cross-country movement. The other poorly drained areas are noncontinuous and may be bypassed with little difficulty on adjacent higher and drier lands. Even the Oka - Vetluga Wet Lowlands (C-3d) are interrupted by 15- to 25-foot sand and gravel swells and short ranges of hills that rise 50 to 200 feet above the swamps (FIGURE II-87). In contrast with this, the Middle Volga Flood Plain (C-3g) south of Kazan' is covered with 5 to 20 feet of water to a width of 3 to 5 miles during the spring flood season from mid-April to early June. At that time these flooded lowlands are a formidable barrier. This barrier effect is increased during the early stages of the flood, from April to early May, by the presence of ice blocks in the floodwaters.

FIGURE II-87. *Vetluga valley east of Gor'kiy.*
Log jam during the spring flood season (April, May) in the Vetluga river, a small northern tributary of the Volga. Most of the low, gravel-filled valley floor is under water at this season. Note the range of forested hills in the background. Before 1941.

Within the Oka - Vetluga Wet Lowlands (C-3d) and Middle Volga Flood Plain (C-3g) most of the poorly drained lands are tree-covered swamps, although there are some grass and reed marshes. Swamps are even more dominant in the poorly drained valleys of the Pre-Volga Hills (C-3f) and Trans-Volga Hills (C-3h) areas. The Middle Volga Flood Plain (C-3g) has many reed- and grass-covered marshes among the extensive swamps.

Only the major streams in the Central Russian Plain (Region C-3)—Don, Oka, and Volga— will be discussed here in some detail. The Dnepr is treated in connection with the Southwest Russian Upland (C-2). The smaller streams in the Central Russian Plain (C-3) are not wide and deep enough to constitute serious barriers except during spring floods (April to May) and at that time their valleys are so deep in mud that the streams can hardly be approached. Banks of these small streams are of clay or loam and are less than 10 to 20 feet high at low water (August to September). The west and the south banks are almost invariably the higher ones. Bottoms of these lesser streams are generally sand and sand loam.

The upper Don river is only 100 to 150 feet broad and 3 to 6 feet deep near its headwaters but increases rapidly southward, and at Voronezh (on the southern boundary of Region C) the river reaches about 660 feet in breadth and 32 feet in depth. During spring high water the Don at least doubles its width and depth. Even small tributaries are then in flood, and many of these flood again after every heavy summer rain (FIGURE II-88). The high west bank of the Don attains elevations of 100 to 120 feet where sections of the Central Russian Hills (C-3b) reach the river.

The Oka river also increases greatly in size within the Central Russian Plain (C-3). The river is 150 feet wide

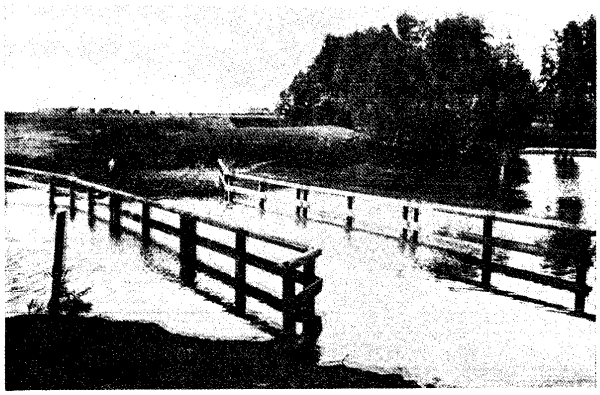

FIGURE II-88. *Stream in flood, upper Don area.*
This typical, easily destroyed wooden bridge is flooded and endangered by a summer rainstorm. For a few hours after the storm the stream will remain deep and wide, a considerable barrier to cross-country movement. Before 1941.

and from 2 to 5 feet deep near Orël in the Central Russian Hills and it reaches 800 to 1,500 feet in breadth with depths up to 40 feet near its junction with the Volga in the swampy lowlands east of Moscow. Sand bars are common, however, and water is only 2 to 3 feet deep over them. All measurements refer to average summer depths. Banks of the Oka are generally low (20 to 25 feet) especially in the wet lowland southeast of Moscow. These low banks are little protection in flood time (April to May), when the river rises at least 25 feet, overflows its banks, and spreads out to a maximum width of 3 miles. Such floods deposit much sediment and, as a result, the channel bottom and the banks of the Oka are made up largely of fine loam near the headwaters and coarse sand and gravel in the lower stretches. The Oka, like the Don, is navigable for small flat-bottomed boats, but would form a greater barrier to military operations.

The Volga is a large stream even in its upper reaches north of Moscow. Near Yaroslavl' the river is 885 feet to 3,500 feet wide and 10 to 14 feet deep. From Gor'kiy to the mouth of the Kama river the Volga ranges between one-half and one mile in width and 15 to 35 feet in depth. However, sand bars in the stretch below Gor'kiy reduce the depth at some points to 4 to 6 feet. Finally, in the great flood plain area south of Kazan', the Volga averages a mile and a quarter in width and 50 to 60 feet in depth, with shallows of 7 to 10 feet. All of the minimum depths quoted for the Volga are increased two or three times during the April-to-June flood period. Although sand bars reduce the effective channel depth of the Volga to 8 to 10 feet below Kazan' and 6 to 8 feet above Gor'kiy, the river is still a great commercial artery and is as effective a barrier to movement as a large stream can be. In common with the Oka, the barrier effect of the Volga is increased by the dense, and in many places swampy, forests along its banks. The high, south and west banks of the Volga, which rise to 300- to 500-foot cliffs south of Kazan', already have been discussed under Relief (Topic 22, C, (4), (a)).

The barrier effect of all the streams in the Central Russian Plain is much reduced during the period when they are frozen over. This ice season lasts from early November to late March in the Yaroslavl' district and continues until early April in the Kazan'-Kuybyshev stretch. During this midwinter period, men and light equipment can cross the ice, especially if it has been reinforced by ice blocks and brush and pole mats.

(c) Vegetation (PLAN 5).—Dominant vegetation in the Central Russian Plain (C-3) is dense forest, with many clearings. These openings in the forest are occupied by crops, meadows, or marshes. In some places the forest has much undergrowth, which is low but dense (FIGURE II-89).

North of the Volga, the forest is dominantly coniferous (fir and spruce, with pine on the sands) but has some oak and poplar on the finer, better-drained soils (FIGURE II-90). South of the Volga, the broadleaf (oak, beech, poplar, hornbeam) trees increase in number and in many parts are dominant (FIGURE II-91). Near the southern border of this subregion trees, chiefly poplar and willow, are limited to the valleys and around the villages where they are planted (FIGURE II-92). Cereals, which are now grown over the greater part of the broad, natural prairies, constitute the main vegetation. Chief crops grown in the clearings of the middle and northern sections of the Central Russian Plain are: barley, potatoes, sugar beets, for-

FIGURE II-89. *Forest with much brush and scrub growth, Moscow area.*
In this early winter view the snow and frost have covered the trees and underbrush and filled the frozen ruts in the road. Before 1941.

FIGURE II-90. *Dense coniferous forest near the Volga, north of Moscow.*
The narrow logging road provides the only path for advance of vehicles through the forest. The surrounding dense growth of large trees provides much cover and concealment off the road. Before 1941.

FIGURE II-91. *Oak forest west of Voronezh.*
Low but dense stand, chiefly of scrub oak. The narrow earth road is typical. Firewood is abundant, but timber is limited in size and amount. Vertical cover and concealment are less here than in forests farther north, but horizontal observation and, to some extent, movement, are obstructed by the scrubby growth, especially when trees are in leaf. Before 1927.

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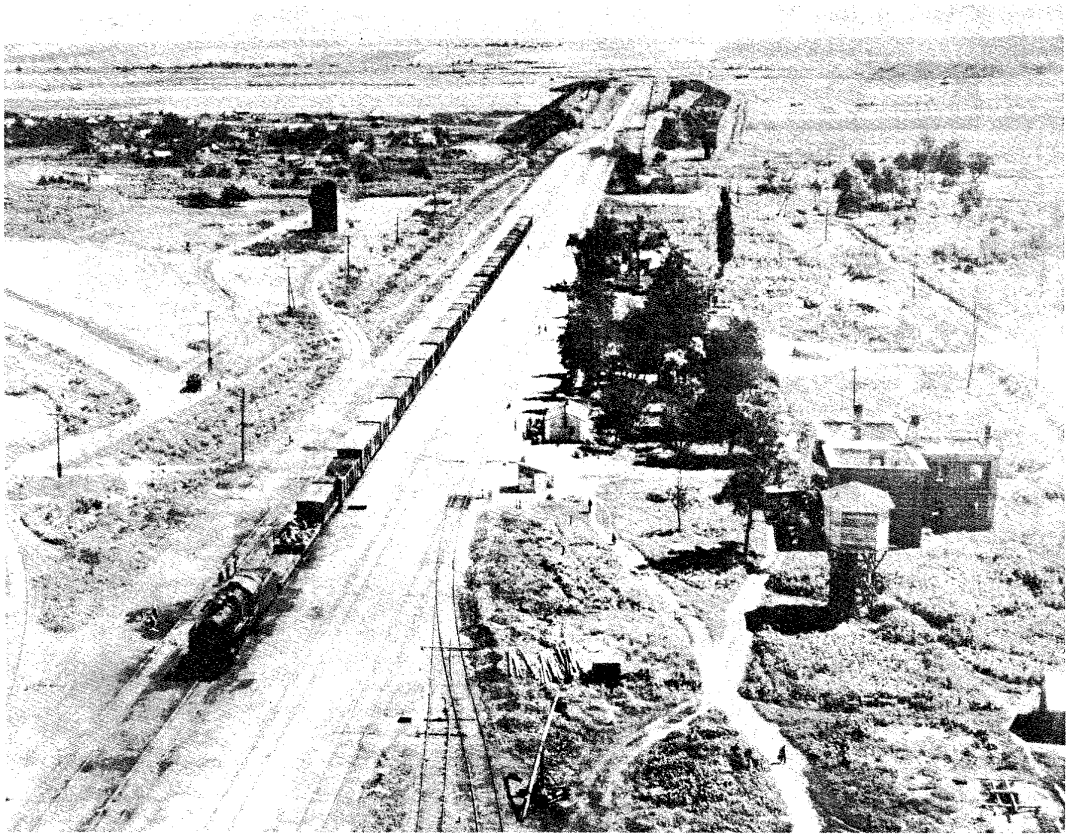

FIGURE II-92. *Southern margin of middle Dnepr plain, west of Khar'kov.*
The broad, flat valley in the middle distance rises gently to the broad, rolling interstream area in the background. Note gullies on slopes in background. Grain crops occupy almost all the surface. Note the scattered trees in the villages and along the railway. 1945.

age, grasses, and garden vegetables. None of these crops offers much concealment or any cover, but the dense forest patches afford excellent concealment and considerable cover (FIGURE II-93). The Soviet armies found in World War II, as the Russian armies found in 1812, that the dense forests on the Central Russian Hills north and west of Moscow were one of the main natural defenses of the city. The swamps and forests along the upper Volga south of Kalinin also helped slow the second great German attack in November and December, 1941. Swamps and forests along the Oka are a further barrier which helped to protect Moscow in 1941.

(d) Trafficability of surface materials (PLANS 6 to 10).—With the exception of the swamps and marshes

FIGURE II-93. *A valley between Mirgorod and Poltava.*
Natural groves in the valley bottom (left) and planted trees around the village on the valley margin (right) break the monotony of the low crop—and pasturelands (center). 1945.

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along the Oka, Vetluga, and middle Volga, and the wet valleys in the Volga Hills, most of the soils in the Central Russian Plain drain quickly and are trafficable most of the year. Chief seasons of soil trafficability and nontrafficability in this subregion are similar to those in the Baltic - West Russian Hills and Wet Lowlands subregion (C-1). The winter season of hard-frozen, highly trafficable soil (late December to March or April) is followed by the spring thaw or mud season (early April to mid-June) with its bottomless roads and generally nontrafficable surfaces (PLANS 6 and 9). By late June the non-swampy ground has dried. Good trafficability then prevails (except after the occasional heavy summer rains) until the short autumn rainy season of October to November (FIGURE II-75). This short mud season helped to halt the first great German drive on Moscow (October 1941). In some years the muddy roads are frozen quickly at the beginning of winter, and the hard ruts are partially filled by early snows, making the roads very rough and almost nontrafficable (FIGURE II-89).

In the Central Russian Plain (C-3) there is little difference between the trafficability of the soils on the hills and those on the plains, as the lowland soils contain more sand and are more porous than the soils on the hills.

D. Region D, Ukrainian Carpathian Mountains

(PLAN 2 and FIGURES II-94 and II-105)

(1) Introduction

The Ukrainian Carpathian Mountains Region is located in the extreme southwest of European USSR. It consists mainly of the central part of the Carpathian Mountains, a range which extends both west and southeast out of the area covered by this JANIS. To the west, the higher and more extensive western Carpathians lie in Czechoslovakia and Poland, and to the southeast the broad southern Carpathians occupy much of Transylvania in western Rumania.

The part of the Carpathian Mountains included in this region is relatively low and narrow, and contains a number of strategically important north - south pass routes between the Hungarian plain and the easily traversed Southwest Russian Upland (subregion C-2). These passes are readily accessible from both north and south over the mountain forelands, which are transitional areas of lower foothill relief included in the Ukrainian Carpathian Mountains Region. From the north a well-developed road and rail net connects with a road and railroad extending along

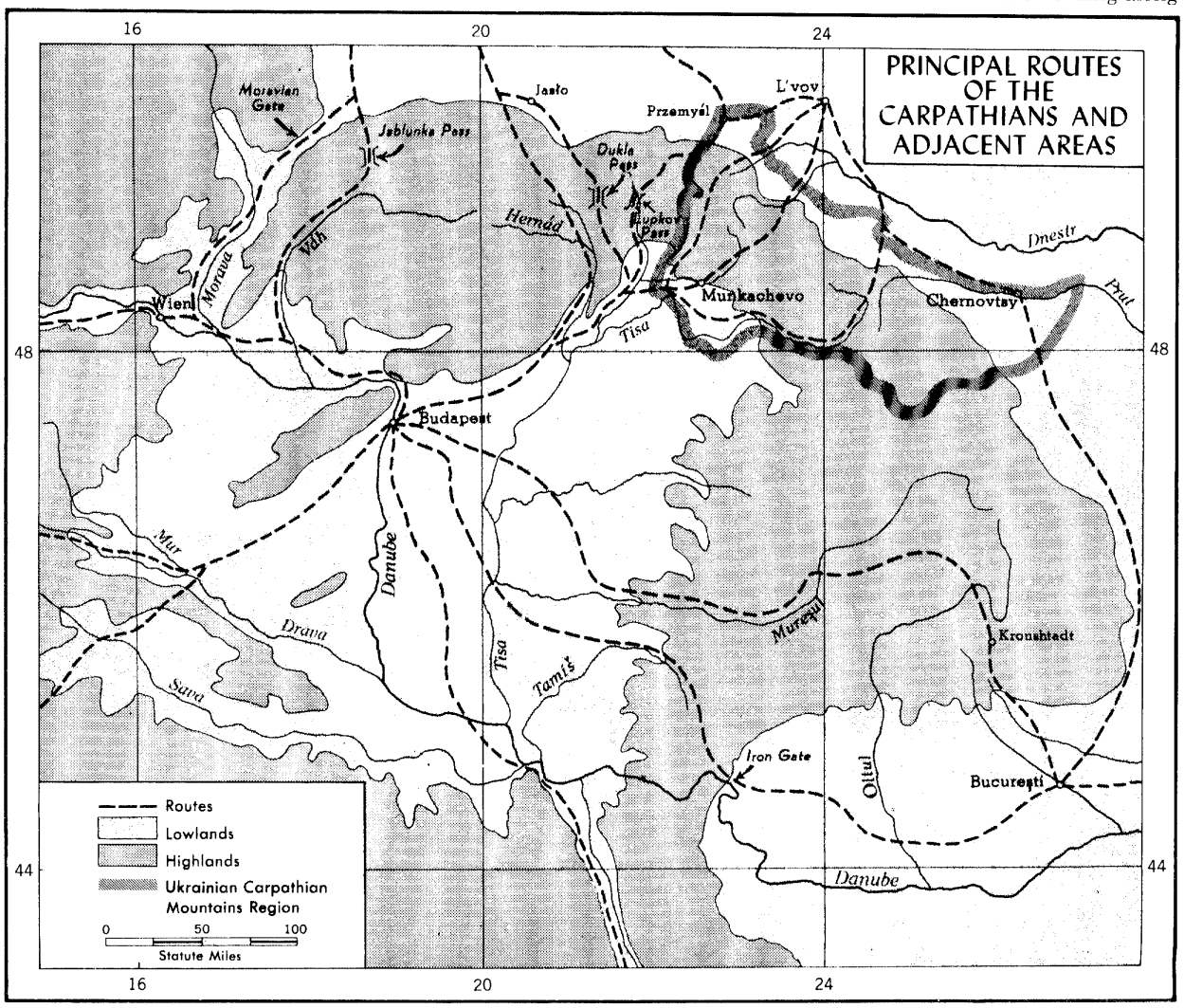

FIGURE II-94. *Principal Routes of the Carpathians and adjacent areas.*

the outer edge of the northern foreland, and from this line four main roads and three railroads extend southward up the valleys and across the mountains. (See FIGURE II-105.) From the south the Hungarian plain provides easy access to the upper reaches of the river Tissa (Tisa) and its tributary streams whose valleys form natural routes across the Ukrainian Carpathian Mountains. Except for the narrow, north - south valleys and the foreland areas to the north and south, however, most of the region is not easily accessible by land. There are no continuous natural routes or lines of communication extending entirely through the northwest - southeast - trending axis of the region, although in many places limited movement is possible in this direction.

The Ukrainian Carpathian Mountains Region forms a crude triangle with the towns of Przemy'sl (Peremyshl'), Uzhgorod (Uzhorod), and Chernovtsy (Cernăuti) lying near the corners. It is approximately 100 miles from the northwestern corner near Przemy'sl to the southwestern corner south of Uzhgorod, and approximately 200 miles from each of these points to the southeastern tip of the region southeast of Chernovtsy. The total area is about 11,500 square miles, approximately as large as Maryland and Delaware combined.

Nearly the whole Ukrainian Carpathian Mountains Region is rugged in relief, although few of the mountains are over 6,000 feet above sea level. The terrain restricts movement to the roads in a few north - south transverse valleys. Outside these valleys cross-country movement is restricted by steep slopes and dense forest vegetation. Lack of roads in most areas limits movement to the transverse valleys. Only in the mountain foreland areas to the north and south are there areas sufficiently level to make cross-country movement feasible. To the north of the main mountains the hilly terrain of the foreland has been largely cleared, and many of the slopes are gentle enough for the movement of vehicles. To the south on the foreland plain the relief is nearly level, and there are few forests which interfere with movement.

Most of the precipitation within the region occurs during the late spring and summer, when heavy rains often turn mountain streams into torrents and the narrow valleys are completely flooded. Extensive areas in the forelands also are inundated when streams overflow. Soil drainage is poor in large parts of the relatively level southern foreland and along the stream valleys in the northern foreland area. In both places the alluvial soils range from medium to fine texture and are likely to be nontrafficable during spring thaws and during and after spring and summer rains.

Population is sparse in the rugged terrain because of the dense forests, and thin mountain soil. Here stock-raising and lumbering are the principal occupations. In the forelands conditions are more suited to agriculture, the land is used for crops as well as pasture, and the population density is much greater. The towns of Przemy'sl, Sambor, Drogobych (Drohobycz), Stryy (Stryj), Stanislav (Stanisawow), and Kolomyya (Kolomyja) are located at the mouths of the principal valleys along the northern border of the region. Their commercial and economic importance is due chiefly to trade, and oil and salt deposits. Uzhgorod and Munkachevo (Mukačevo) are agricultural market towns located on the foreland plain south of the Carpathians. All of the towns are transportation centers, and among the routes radiating from them are some that extend across the mountains.

Within the Ukrainian Carpathian Mountains Region are three natural subregions which vary primarily in relief and vegetation. The Russian Carpathians Range subregion refers strictly to the main mountain mass, whereas the Northern Foreland subregion designates the hilly terrain which merges into the gently undulating Southwest Russian Upland north of the Carpathians. South of the Russian Carpathians Range lies the plain of the Southern Foreland which, as the Hungarian plain, extends southward out of the area covered by this JANIS. Each of these subregions will be discussed separately.

(2) Subregion D-1, Russian Carpathian Range (PLAN 2 and FIGURE II-105)

(a) Relief.—The Russian Carpathian Range is a link between the higher western and broader southern Carpathian Mountains; the Range comprises a major part of the low central or forested Carpathians. The Range extends northwestward from the headwaters of the Tissa (Tisa) river beyond the western limit of this JANIS area. West of this arbitrary boundary, immediately outside the JANIS area, the mountains and the crests are so low and rounded that they are merely hills with easy north - south routes between the Polish and Hungarian plains. Still farther west, the true western Carpathians are a real mountain barrier to north - south communication.

The Russian Carpathian Range consists principally of a main sandstone range and a southern belt of old volcanic materials. These mountains form an arc trending northwest - southeast. The average width of the mountains is about 60 miles, and highest elevations are between 3,000 and 5,500 feet above sea level in the west and between 4,500 and 6,750 feet in the east. In the western part of this subregion, stream valleys and valley basins are more numerous and passes are generally lower (FIGURES II-95 to II-97).

FIGURE II-95. *Low, rounded mountains near Uzhok.* Direction unknown. Mountains in the western part of the Ukrainian Carpathians are much lower and more rounded than the mountains in the eastern part, and the valleys are wider. Much of the original forest has been destroyed and large areas of hill and mountain land are utilized for pasture. Before 1936.

West of the river Stryy in the northwestern part of the subregion the mountains consist of numerous parallel ridges trending northwest - southeast. The many crests of these ridges are gently rounded, with most of the heights ranging between 1,500 to 2,500 feet above sea level. Movement through this northwestern part of the subregion is relatively easy, as the upper Dnestr and several of its tributaries form fairly broad transverse valleys through the parallel ridges. There are likewise many discontinuous northwest - southeast valleys between the ridges. These valleys, drained by small streams, have been mostly cleared and are inhabited. Lower slopes of the ridges have gentle grades.

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FIGURE II-96. *Valley basin along the Opor at Skole.*
Probably looking southeastward. Section of railway in foreground is the main line connecting the towns of Stryy and Munkachevo via the Beskid Pass. This basin is about 1 mile wide and 2 miles long. It narrows to a width of a few hundred yards at each end. The Opor flows along the base of the Russian Carpathian Range shown in background. Before 1941.

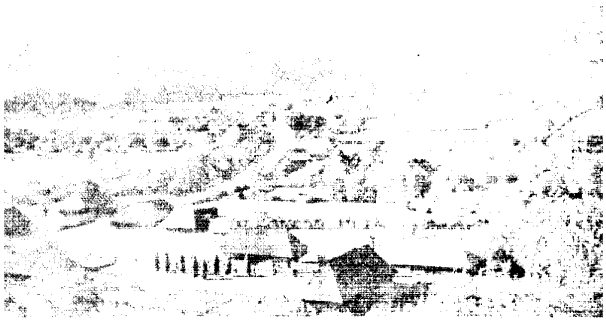

FIGURE II-97. *Valley basin at Volovets (Volove).*
Direction unknown. One of the few valley basins in the Russian Carpathian Range. These north - south trending valley basins located near the upper southern slopes of the mountains form part of the natural transverse routes across the mountains. The valley basin is almost entirely cultivated. Before 1936.

A fair network of roads covers this area west of the Stryy, but as a rule these roads are unimproved and in poor condition. Only two main roads and two railroads cross the mountains in the western part of the subregion. One main road and a railroad extend northward from Uzhgorod up the river Ug (Uh), across the Uzhok (Užok) Pass at an elevation of 2,915 feet, and down the Dnestr to the towns of Sambor, Przemy'sl, and L'vov (FIGURE II-105). A second road and railroad extend northward from Munkachevo along the river Latoritsa to the village of Svalyava (Svalava). At this place the transportation lines divide. The railroad follows a northeasterly tributary of the Latoritsa to the Beskid Pass, with an elevation of 3,215 feet at the tunnel, follows the Opor valley to the Stryy, and then turns northward to the towns of Stryy and L'vov. The road northward from Svalyava winds through several small east - west and north - south valleys to the mountain crest at Pereval Veretskiy, which is located some 12 miles west - northwest of the Beskid Pass at an elevation of 2,759 feet. This road then swings northward to the Opor valley where it again parallels the railroad to the town of Stryy. This road and railroad form the most important route across the central Russian Carpathians.

Southeastward from the Stryy the parallel ridges of the Western Russian Carpathian Range unite and form a more massive type of mountain chain. This mountain chain, known as the Gorgany chain, extends from the Pereval Veretskiy to the Tatar Pass in the area containing the source of the Prut. These mountains, which are deeply cut by transverse valleys, are higher and more rugged than the parallel ridges to the west. Slopes are steep, although just south of the crest line there are large summit areas with rolling relief at elevations about 4,000 feet. These highland areas are extremely isolated but are used by herders during the summer after the snows melt.

Within such mountains large areas are covered with sandstone blocks which, together with the deep narrow gorges of the upper stream valleys, make movement extremely difficult.

Except for the passes at each end of the Gorgany chain, there are no important passageways across this section of the Russian Carpathian Range. A main road extends northward from Chust (Khust) up the Rika to the crest of the divide, but continues as a secondary road part way down the northern slope, where it connects with a main road to the town of Dolina. A railroad extends part way up the southern slopes from Khust.

The Gorgany chain of mountains merges on the south with the Charnogor (Chernogora) range which extends southeastward out of the subregion and the JANIS area (FIGURE II-98). The Charnogor range is composed of hard sandstone and has an elevation of 6,750 feet above sea level at Gora Goverla (Mt. Hoverla), the highest elevation in the Russian Carpathian Range. Much of the Charnogor is extremely rugged and densely forested. It is suitable only for limited mountain-type operations. Snows further impede cross-country movement within the area during the winter. Movement across the divide is impeded by long ridge summits rising more than 5,000 feet above the elevation of the valley bottom of the Tissa (Tisa) at Sighet. Passes through these summits are not opposite each other, but can be linked circuitously by way of the intervening valleys. Such routes furnish the few feasible ways across the Charnogor range. The principal pass in this area, the Tatar Pass, at an elevation of 3,054 feet above sea level is part of such a trans-mountain route. The main road extends up the Tissa (Tisa) from Sighet, over this pass, and down the headwaters of the Prut to the foothill town of Delyatin (Delatyn). The railroad passes the crest of the range via a tunnel at an elevation of 2,883 feet. This pass is a few miles southeast of the road.

FIGURE II-98. *Khrebet Charnogor.*
rounded summits are the highest mountains in the Russian Carpathian Range. Dense forests cover the slopes to an elevation of approximately 5,000 feet; summit areas are covered with snow for about 9 months of the year. Before 1941.

On the south side of the Russian Carpathian Range is a narrow fringe of old volcanic mountains consisting of several groups of mountains which are separated from the main sandstone mountain range by a nearly continuous valley trough, one to three miles wide. From east to west these volcanic mountains are divided into separate groups by the main headwater streams of the Tissa (Tisa). Each of these groups of mountains is about 8 miles wide and 20 miles in maximum length. Most of the old volcanic mountain groups are low and rise from 1,000 to 2,000 feet above the level of the plain with the highest elevation at 3,523 feet above sea level. The mountains are rounded and the slopes are not steep. Movement throughout the area

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would not be difficult. Main roads and railroads follow the principal valleys, and numerous secondary roads and trails extend along the numerous small tributaries.

(b) Drainage (PLAN 4 and FIGURE II-105).—Stream flow in the Russian Carpathian Range is irregular, due to the seasonal distribution of precipitation, and the impermeability of the rock. During the spring and summer rains and during periods of sudden thaw, streams in the mountains rise in a few hours, and become torrents. Normally the water recedes in a short time. In narrow valleys the floods may occupy the whole valley bottom, thereby rendering the valleys impassable.

The northern slopes of the Russian Carpathian Range are drained principally by the upper headwaters of the Dnestr and its tributaries. Only a narrow fringe along the northwestern margin of the area drains westward toward the headwaters of the San and on into the Wista (Vistula). The Dnestr flows in a general northeast direction to the northern boundary of the region at Sambor, where the course of the stream changes to a southeastern direction parallel to the mountains. Here the stream is 10 to 20 miles north of Region D. Principal tributaries of the Dnestr flowing northeastward from the Russian Carpathian Range include the Stryy, Svitsa (Swica), Lomnitsa (Lomnica), and the Bystritsa (Bystrzyca). These streams are narrow and shallow except during the periods of high water. In the southeastern part of the subregion, the northern slopes of the mountains are drained mainly by the headwaters of the Prut and its tributary, the Cheremosh (Czeremosz) (FIGURE II-99).

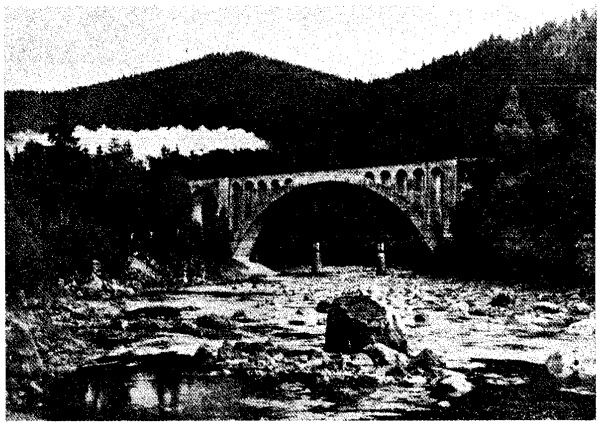

FIGURE II-99. *Upper course of the Prut.*
Direction unknown. Looking downstream near Yaremcha (Jaremcze), south of Delyatin (Delatyn). The stream bed is rocky and the valley slopes, which are covered by leaf forests, are steep. The single-track railway viaduct and road bridge are on the main communication lines between Kolomyya and Khust (Chust). Before 1941.

The southern slopes of the Russian Carpathian Range are drained by the Tissa (Tisa), which rises in the eastern part of these mountains near the Tatar Pass. This stream flows southward in a long gorgelike valley, and during high water the stream is a mountain torrent (FIGURE II-100). Due to its normally irregular flow, dams have been constructed in the mountains to regulate the flow of water. During dry periods in the summer months, when the water level is too low to float logs, dams are opened periodically to create a larger flow of water. Any military movement along the stream might be endangered if waters impounded by these dams were suddenly released.

Numerous tributaries flow southward down the slopes of the mountains to the Tissa (Tisa). From west to east,

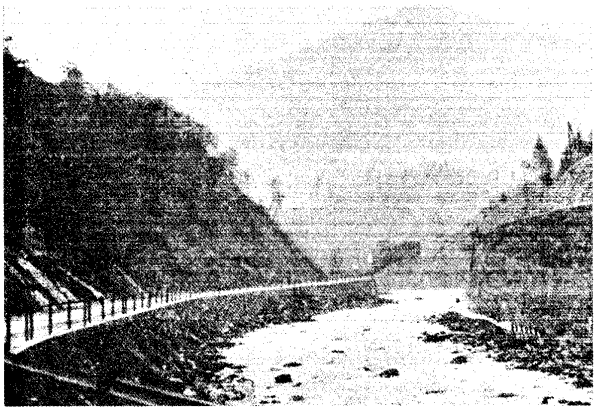

FIGURE II-100. *The Chernaya (Black) Tissa.*
Direction unknown. Looking downstream near Yaremcha Yasena (Jasina). Typical of the narrow, steep-sloped mountain valleys which are filled with torrents during spring thaws and following heavy summer rains. Landslides and wash-outs often destroy lines of communication such as the road at the left. Before 1936.

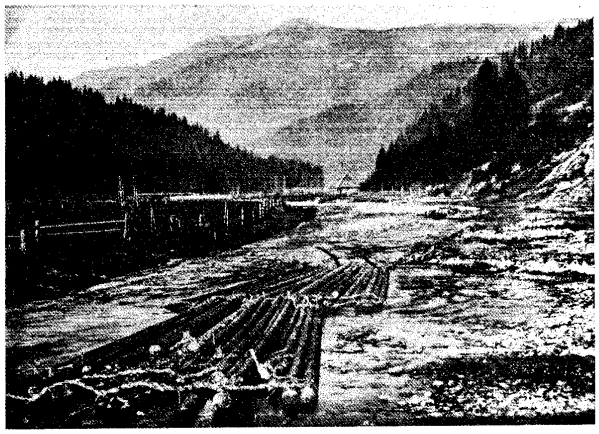

FIGURE II-101. *Valley of river Tereshva.*
Exact location unknown. The valley of the river Tereshva is typical of the narrow valleys of the Russian Carpathian Range. During spring thaws and periods of heavy summer rains, the entire valley bottom may be covered with flood waters. Valley slopes are generally steep, and mountains are largely covered with forest. Log rafts are floated downstream during periods of high water but may strand, as appears to be the case in the picture, when the water level falls. Before 1936.

the principal streams are the Ug (Uh), Latoritsa, Rika, Terebla, and the Tereshva (Teresva) (FIGURES II-101 and II-105). Most of these streams, before entering the plain, are typical mountain streams with rocky beds and wide fluctuation of flow.

(c) Vegetation (PLAN 5).—Characteristic vegetation of the Russian Carpathian Range is heavy forest on the slopes and natural grass-herb pasture above the timber line (FIGURE II-102). Much of the original forests has been destroyed either by fire or lumbering, especially in the western part of the subregion, where the mountains are lower and less rugged, and along the valleys where the forest is most accessible. Generally, the mountains are forested up to an elevation of 4,000 feet and in some places 5,000 feet. Large areas of high, rolling ridges above the tree line are covered with a natural alpine-pasture type of grass. These areas of natural pasture, called *poloninas,* are used for the summer grazing of cattle and horses brought up from the lower slopes and valleys. Only patches of juniper

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FIGURE II-102. *Forested mountains of the Russian Carpathian Range.*
Direction unknown. View of Bystri valley west of Uzhok near the crest line in the western part of the Russian Carpathian Range. Mountains of sandstone are rounded, and higher slopes are covered with forest. Relief, combined with vegetation, tends to restrict movement to a few main lines of communication. Before 1936.

or outcrops of bare rock break the monotony of these natural pastures. On the lower slopes the trees are principally broadleaf, chiefly oak and beech, and at higher elevations, mainly conifers. Wider valley bottoms for the most part are cleared for cultivation. Principal crops are grains, beets, and potatoes.

On account of their greater height and difficulty of access, the Gorgany chain of mountains remains covered with thick forests of tall trees. The lower, wooded zone has beech forests, mixed with ash, maple, pine, and fir, whereas the upper wooded zone is almost entirely pine. The timber line is very irregular, ranging from 3,000 to 5,000 feet elevation. Extensive tracts of creeping mountain pine, through which it is difficult to pass, partly cover the rock heaps on the slopes.

The slopes of the Charnogor range are covered with thick woods. Oak forests containing dense underbrush cover the lower slopes; above this zone are mixed forests of beech, birch, ash, maple, fir, and pine. Above an elevation of approximately 4,000 feet there is a belt exclusively of dwarf pines which extend to an elevation of somewhat over 5,000 feet.

Dense forests combined with rugged, high mountain relief make military operations difficult, especially in the eastern half of the Russian Carpathian Range. During the military operations in the World War I, however, due to the many clearings, the forests proved to be far less a barrier to movement than was anticipated.

(d) Trafficability of surface materials (PLANS 6 to 10).—Rugged relief and steep slopes cause generally nontrafficable conditions in the Russian Carpathian Range, regardless of surface materials or weather, except locally or on established routes of travel in the valleys. Most of the mountains have well-drained soils covering bedrock. These soils consist of mixed shallow-and-deep loams and clays weathered from the parent rock. Depressions and mountain basins are filled with fine-to-coarse alluvial materials. On slopes soil depth varies from a few inches to several feet; on rolling upland and depressions the depth ranges from a few feet to many feet. Bedrock outcrops locally, and rock fragments are scattered through the soils. Sandstones and the other local rocks erode and weather easily. Consequently, huge landslides, which often destroy the roads, frequently occur in the mountain valleys.

Forest ground is very wet after heavy summer downpours, causing sudden heavy run-off which fills mountain creek and stream valleys, rendering the area almost nontrafficable immediately after storms. Run-off, however, is comparatively rapid due to the steep slopes, thin soils, and impermeable nature of the bedrock.

In winter snow cover at higher elevations and on the summits is several feet deep; on the Khrebet Charnogor snow covers part of the surface for nearly nine months.

(3) Subregion D-2, Northern Foreland (PLAN 2 and FIGURE II-105)

(a) Relief.—The Northern Foreland subregion is between the most conspicuous break in slope and height of the

FIGURE II-103. *Northern Foreland.*
Looking westward along the northern edge of the Russian Carpathian Range from the area where the Prut enters the foreland area. The town of Delyatin (Delatyn) is located in the basin at left background. Low, foreland hills with gentle-to-medium slopes have been largely cleared of forests, which makes cross-county movement comparatively easy. Trees afford some concealment. Most of the land is either under cultivation or in pasture. Before 1941.

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Russian Carpathian Range and the northern boundary of the region. Thus on the north, the hilly foreland grades gradually into the rolling uplands of subregion C-2. The foreland fringes the mountains for the entire length of the region, and varies in width from a few miles to a maximum width of about 30 miles. The terrain is gently undulating-to-hilly with numerous alluvial valleys cutting across the area (FIGURE II-103). General elevation above sea level ranges from approximately 750 to 1,000 feet with the higher foothills of the Carpathians reaching an elevation of about 2,500 feet above sea level.

Movement throughout the Northern Foreland is relatively easy. The slopes of the hills generally range from 15% to 30% and movement is not confined to the roads during the dry season. The valleys permit easy access to the mountains. Locally, however, movement is hindered by gullies and by streams which are entrenched in the valleys. In many places movement across the streams would be channeled through breaks in the discontinuous bluffs and stream embankments.

A relatively poor network of roads serves the subregion. A main road and railroad extend along the northern edge of the foreland area and lateral lines extend southward up the main valleys and across the mountains. Otherwise communications consist mainly of secondary roads and paths.

(b) Drainage (PLAN 4 and FIGURE II-105).—Most streams of the northern slopes of the Russian Carpathian Range extend across the foreland in a northeasterly direction and enter the Dnestr, which flows southeastward, roughly parallel to and a few miles to the north of the northern boundary of the region. As the mountain streams enter the foreland area they decrease in velocity and increase in width. A few meander widely over broad valley floors (FIGURE II-104). The streams range up to an average depth of 5 feet and vary in width up to about 300 feet. Natural fords provide means of crossing even the larger streams during periods of normal flow. Marshes extend along several of the streams and also cover several large interstream areas.

(c) Vegetation (PLAN 5).—Most of the foreland has been cleared of the original forest growth and now is either under cultivation or utilized for grazing. Valleys and lower slopes are mainly in cereals, beets, potatoes, and pasture. On the higher, or steeper slopes, the dominant vegetation includes natural grasses in pasturelands, and woods of broadleaf trees.

(d) Trafficability of surface materials (PLANS 6 to 10).—In the Northern Foreland there is generally fair trafficability on relatively level-to-hilly terrain. Soils consist principally of fine-textured loam and clay. The fine-textured surface soils dry slowly after the heavy summer rains. As a result, movement is stopped for approximately three weeks during spring thaws, from the latter part of March until the middle of April. This period is followed by short periods of poor trafficability during the month of May; movement becomes fair in June, and is normally good from July to November.

From December to late in April, frozen ground renders the soil trafficable, but movement is hindered by frequent and heavy snows, which average from 10 to 15 inches per month from November to April. Hilly land with slopes mainly 15% to 30% in gradient dominates the area, thereby furnishing good drainage. Tracked vehicles can move on most of these slopes when soils are dry, but steeper slopes stop all types of vehicles.

Along the lower flood plains within the region, the soils vary in texture from coarse, near stream channels, to fine farther back from the streams. Natural drainage differs widely according to season. In contrast with conditions

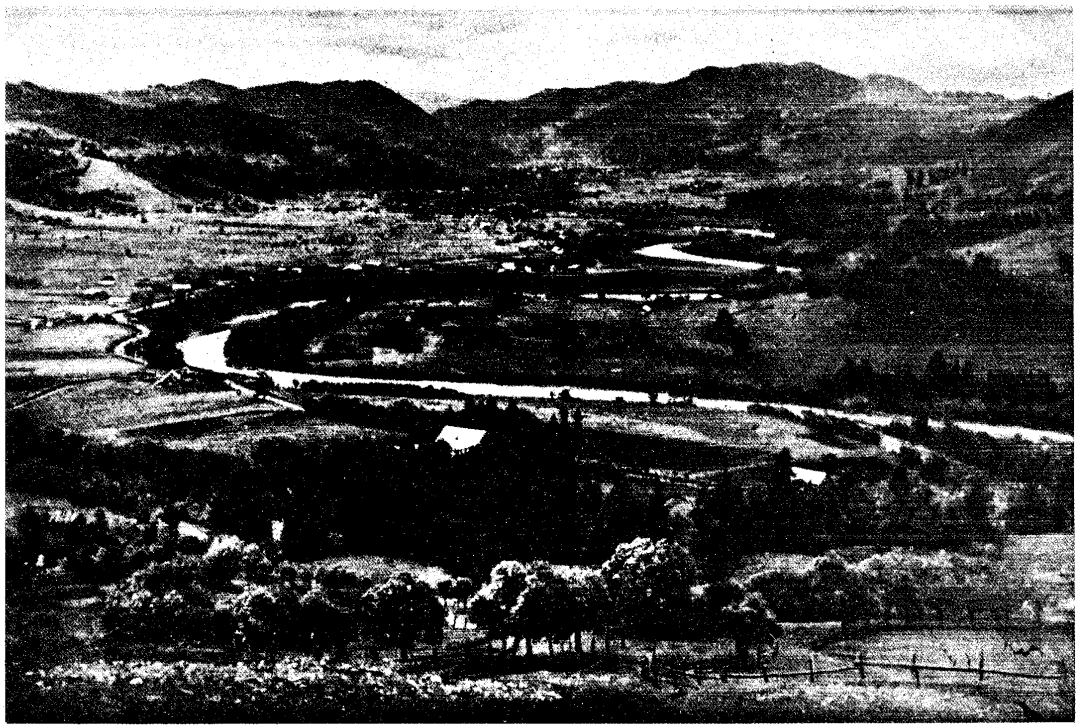

FIGURE II-104. *Cherna Cheremosh Stream at Zhab'ye (Zabie).*
Probably looking eastward downstream toward the outlying Khrebet Chernogor. Entrenched and meandering Cherna Cheremosh with relatively wide valley and gentle slopes in foreground. Farm houses are widely scattered throughout the valley and on lower slopes. Before 1941.

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FIGURE II-105
UKRAINIAN CARPATHIAN MOUNTAINS
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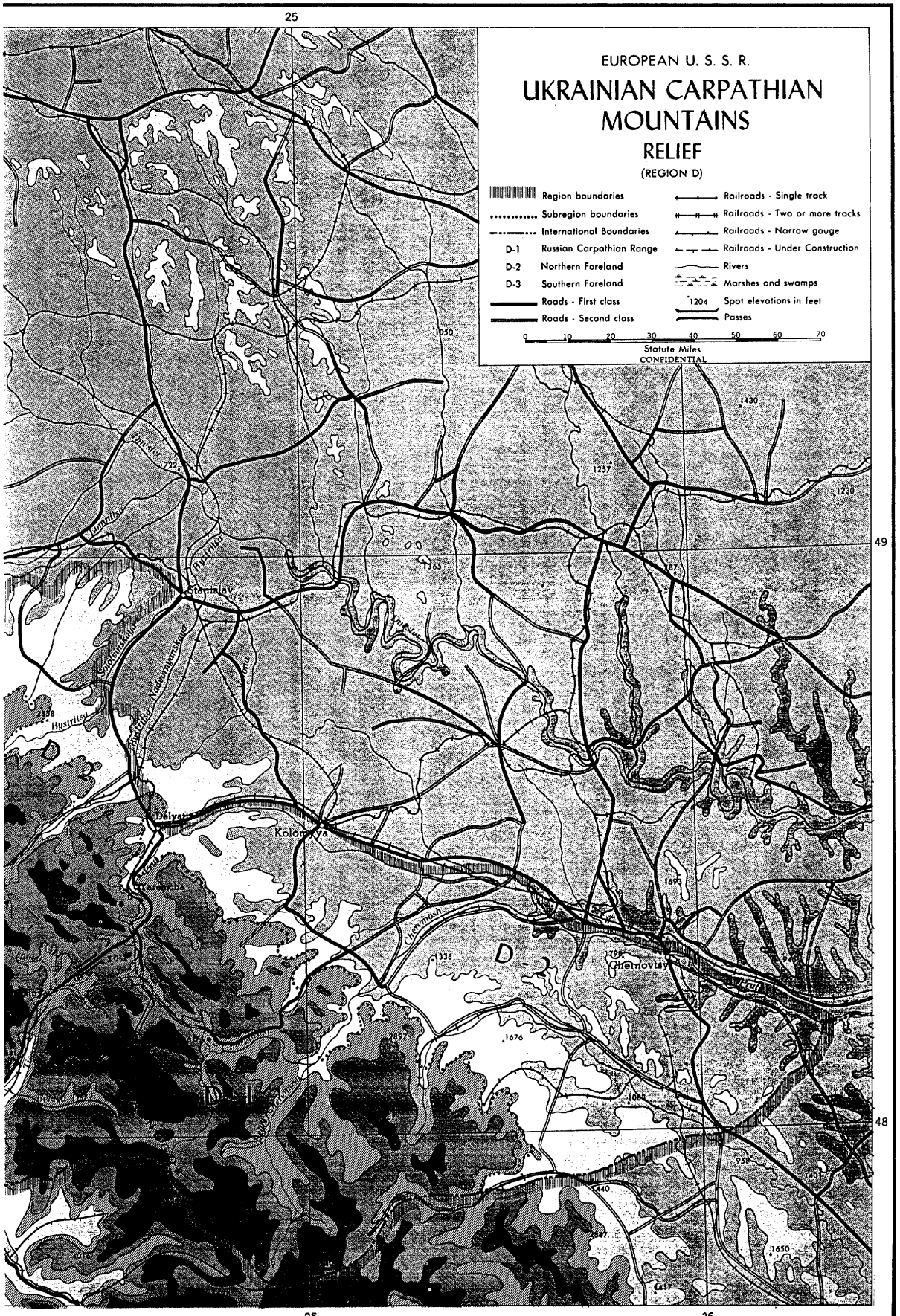

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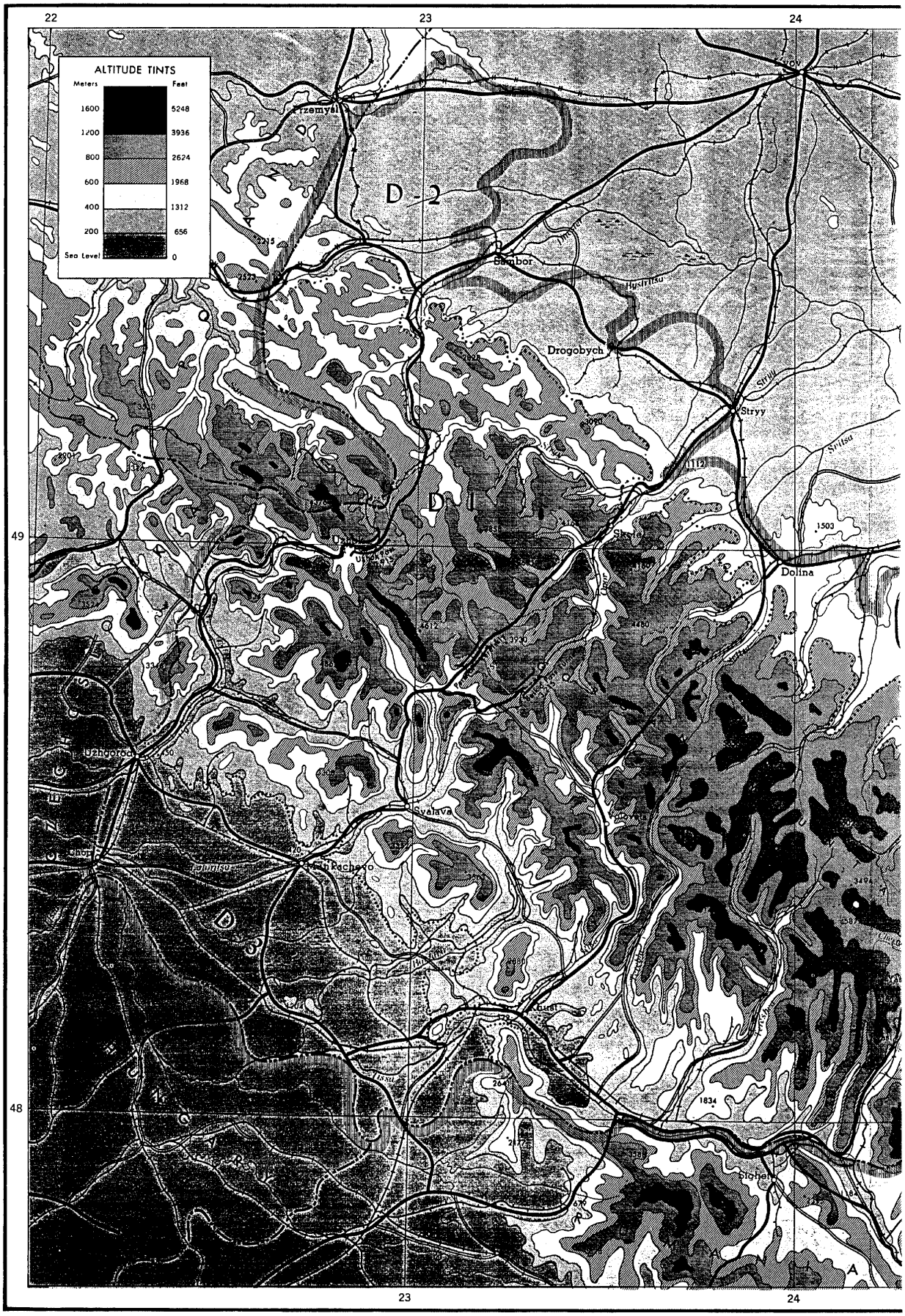

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prevalent in the level-to-hilly terrain of the foreland, movement is stopped on the lower flood plains for about five weeks in April and May, during spring thaws of the snow on the higher levels. Short periods of poor trafficability follow during June and July, but movement in summer is generally good on well-drained areas; poorly drained areas always must be detoured.

(4) Subregion D-3, Southern Foreland (FIGURES II-94 and II-105)

(a) Relief.—The Southern Foreland extends from the gentle slopes of the old volcanic mountains, which are part of the main Russian Carpathian Range, to the extreme southwestern boundary of the region. This subregion is actually the northern fringe of the Hungarian plain and has a northeast - southwest width of about 20 miles and a length of about 55 miles. Elevation above sea-level near the foot of the Carpathians is only about 350 to 500 feet, and most of the plain is nearly flat. Relief in itself offers no continuous barrier to cross-country movement, drainage being the principal hindrance to movement.

(b) Drainage (PLAN 4 and FIGURE II-105).—Streams emerge from the mountains and meander across the plain. Some of the streams disappear in marshes. Hundreds of miles of dikes have been constructed along the banks of the streams but, even so, large areas are threatened each year with inundation during the periods of spring thaw and heavy summer rains. Revetments and embankments have been constructed along many of the roads and railroads within this area.

The principal stream draining the southern slopes of the Russian Carpathian Range is the Tissa (Tisa) with its tributaries. The Tissa (Tisa) flows southward in the eastern part of the Ukrainian Carpathian Region, but at the foot of the mountains it turns westward and enters the Hungarian plain near Khust. As the river debouches from the mountains, in a broad valley which is a part of Subregion D-1, the stream drops less than 10 feet per mile, and its depth is little more than three feet. After the Tissa (Tisa) enters the foreland plain its depth increases to over eight feet, and its gradient diminishes to about two feet per mile. Southwest of Khust the river flows along the boundary of the region for several miles, then makes a wide bend to the south into Hungary, and finally cuts back across the extreme southwestern corner of the region at Chop (Čop).

Most of the tributaries of the Tissa (Tisa) before entering the plain, are typical mountain streams with wide fluctuation of flow, but between Uzhgorod and Khust they widen as they leave the foot of the mountains and meander across the plain to the Tissa (Tisa). Several of the streams flow in a network of channels.

(c) Vegetation (PLAN 5).—The forests of the Southern Foreland now cover only 20% of the total area, and cultivated crops occupy 50% to 60%. Principal crops are cereals. About 10% of the land is in pasture, and an equal amount lies fallow.

(d) Trafficability of surface materials (PLANS 6 to 10).—The surface materials of the Southern Foreland consist mainly of medium-to-fine-textured river deposits which are nontrafficable except during dry weather. Several areas of marsh in the central part of the plain are impassable to wheeled vehicles throughout the year, and extensive areas are flooded after heavy rains for a considerable period, due to the generally poor drainage. Numerous areas are criss-crossed by irrigation and drainage ditches which would impede cross-country movement.

Frequently the heavy summer rains in the mountains and the rapid run-off cause the streams on the plain to overflow their banks, rendering areas untrafficable or difficult to negotiate. Large areas could be flooded easily for military purposes by breaching embankments or dikes along the streams. In late summer the soils are generally dry and trafficability is good. Freezing temperatures occur during the winter months, and the top soil and streams freeze, but not deeply enough during normal years to support heavy equipment.

E. Region E, Grassland Belt

(1) Introduction (PLAN 2)

The vast Grassland Belt (Region E) is in the southern portion of the area included in this JANIS. It lies south of the Belt of Forests and Clearings (Region C), east of the Ukrainian Carpathian Mountains (Region D), and west of the Volga-Caspian Desert (Region G). On the south the region is bordered by the Black Sea, the Mountainous Crimea (Region F), and the Sea of Azov. The Grassland Belt includes much of the vital Ukraine but only the northern three-fourths of the Crimean Peninsula (E-3, Crimean Grassland). The region has a maximum east - west length of more than 1,300 miles and a maximum north - south width of 550 miles. These are the approximate distances from Washington, D. C., to Houston, Texas, and from Washington, D. C., to Savannah, Georgia, respectively. The area of the Grassland Belt is about 250,000 square miles, about the combined areas of California and Oregon.

This Grassland Belt has no outstanding terrain obstacles to movement. Its wide expanses of level-to-rolling, grass-covered plains have for centuries provided the most convenient and best natural route between the east and west for both traders and invaders.

Both agriculture and industry have significant positions in the economy of the Grassland Belt. Very little undeveloped land remains. The more moist areas in the west and south supply the USSR with most of its cereals, vegetables, and fruits. Agriculture is highly mechanized and depends greatly upon power from gasoline. This dependence makes agricultural pursuits particularly vulnerable in time of war. Agricultural products form the bases for such industries as milling, sugar-refining, brewing, and distilling. The drier portions of the Grassland Belt support a more pastoral economy with its related industries. In addition, there are large deposits of coal in the Donets Hills and iron ore near Krivoy Rog and on the Kerch Peninsula. There also are large deposits of limestone, fire clays, manganese, mercury, bauxites, and salt, all of which are vital to war industries.

Furthermore, the Grassland Belt is highly urbanized. It contains such cities as the ports of Odessa, Rostov-na-Donu (Rostov-on-the-Don), Kherson, and Taganrog; the smelting centers of Krivoy Rog, Mariupol', and Taganrog; the coal mining center of Stalino; the locomotive-manufacturing center of Voroshilovgrad; the aluminum and chemical center of Zaporozh'ye; the hydroelectric center of Dnepropetrovsk (Dniepropetrovsk); the industrial centers of Rostov-na-Donu and Stalingrad; and the commercial and oil-refining center of Kuybyshev.

The Grassland Belt is a part of the Great Plains of Central Europe which extend almost unbroken from the Carpathian Mountains on the west to and beyond the eastern borders of this JANIS. Its outstanding relief characteristic is its vast expanse of generally level-to-rolling, open and

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treeless, low-lying terrain. Northward there is no natural barrier; the northern section merges more or less imperceptibly with Region C. The monotony of the plain surface, however, is considerably broken by minor relief features such as wide, relatively shallow valleys of southward-flowing streams which cross the area, local gullies, and a few isolated groups of low hills. Gullies and ravines are found principally in the steeper right banks of the streams. These steep, high, right (west) banks are conspicuous and constitute the major relief features. Only a few areas are as high as 600 to 1,000 feet above sea level.

In general, most of this Grassland Belt is adequately drained by the lower reaches of such wide streams as the Prut, Dnepr, Dnestr, Donets, Don, and the Volga which form barriers to cross-country movement. Furthermore, the low gradients of all these streams are contributing factors to the flooding of land adjacent to the streams, particularly the left (east) bank, during the spring break-up and after heavy or continued rains. Left banks are in general marshy, and movement is restricted during all seasons except mid-winter, when most surface materials are deeply frozen, whereas right (west) banks are moderately high and in places clifflike. Salt marshes, shallow salt lakes and estuaries (*limany*) along the coast, and wet meadows along major streams form significant but localized terrain barriers to movement, principally in summer. Tall reeds and marsh grass may offer some concealment from ground observation.

Potable water is scarce, particularly in the more southern sections because of the low annual rainfall, low water table, and in places, the salinity of the soil. As a rule, deep wells or artesian wells furnish the only good water available to the inhabitants of the region. Settlements, however, extend ribbonlike along the high right banks of streams so as to take advantage of the river water and the good soil and surface drainage afforded there. Small streams are often dammed so as to store water for irrigation and drinking purposes during droughts.

The climate is characterized by great seasonal, and at times sudden day or night, fluctuations in temperature. The annual amount of precipitation also varies, but averages about 16 inches in the west near Odessa and decreases rapidly toward the east. Precipitation is mainly in late spring or early summer; snow cover is light. Detailed climatic data are presented in Chapter V, 54.

Natural vegetation in the Grassland Belt, as the name implies, is dominantly grass of various types. Feathergrasses, which cover most of the uncultivated portions of the northern part of the Grassland Belt, are tall enough to conceal crouching men from ground observation. Tracks through the grass can be readily observed from the air. The short grass in the drier southern and eastern portions of the Grassland Belt offers no concealment. Cultivated fields of wheat, rye, sweet clover, and sunflowers offer best concealment in late spring and early summer but even then concealment is afforded only for very low objects. Some scattered wooded sections situated along stream banks and on the more moist portions of valley slopes provide limited concealment.

Cross-country travel is comparatively easy because of the low grass vegetation and extensive areas of gentle slopes, even though numerous minor relief features such as low hills and ridges, river valleys, gullies, and ravines are local obstacles to movement. The lack of any major natural terrain barriers other than rather high, mostly earthen, stream banks within this vast Grassland Belt gives military significance to the region, for its terrain is well suited for large-scale mechanized warfare. Many battles of World War II were fought within the Grassland Belt.

Even though terrain conditions favor movement in most places, cross-country travel is restricted or may be completely stopped during spring thaws and rains and late fall rains for a period of several weeks. At these times deep, sticky mud mires vehicles. Winter is most favorable for movement because most surface materials are frozen deeply enough to support all types of vehicles. Late summer is also favorable to cross-country movement because surface materials are dry and climatic conditions are not severe. At this time, however, thick clouds of dust are stirred up by any movement across the area and mark the course of an individual machine, rider, or major unit. This dust is harmful both to machines and personnel.

The comparative lack of usable vegetation for concealment in the dominantly grass vegetation of Region E is a handicap to all forms of movement, particularly by day. The scattered trees furnish only limited concealment. A long mud period during the spring thaw and break-up and another shorter mud season in autumn hinder, and in many years prevent, movement.

Special equipment is required to negotiate the soft surfaces during these mud seasons and during or after heavy showers or prolonged rains in summer. Furthermore, the great width of the rivers crossing the region and poorly drained flood plains adjacent to them call for special equipment adaptable to crossing such barriers.

Within the Grassland Belt, there are three major subregions: 1) the Black Sea - Azov Grassland; 2) the Khoper-Volga Grassland, and 3) the North Crimean Grassland. Each of these subregions contains variations in relief, drainage, vegetation, and soils. Each subregion will be discussed separately.

(2) Subregion E-1, Black Sea - Azov Grassland

The irregular-shaped, east - west trending Black Sea - Azov Grassland is a gently undulating plain which increases in elevation inland from the Black Sea and merges with the Forest and Clearings Belt (Region C) and the Russian Carpathian Mountains (Region D). This subregion extends about 800 miles from west to east, and about 300 miles from north to south. There are numerous local terrain differences.

(a) Relief (PLANS 2 and 3).—Within the Black Sea - Azov Grassland, is the Black Sea Coastal Plain, a strip of relatively level land at altitudes from 100 to 300 feet and from 20 to 110 miles wide. This coastal plain extends about 600 miles along the northern shores of the Black Sea and Sea of Azov (Azovskoye More) from the mouth of the Danube in the west to Rostov-na-Donu at the mouth of the Don in the east (PLAN 2, Subregion E-1a and FIGURE II-106). No well-defined limit can be given for the northern boundary of this low, flat plain, for it rises gradually from the coast and merges in the north with the central uplands (Region C). Despite the uniformity of this area, there are terrain variations which have military significance. Among these are innumerable large barrows (*mogily,* or old burial mounds), and low, conical, granite outcrops. Most of these are located on watersheds and therefore are the high points and afford good observation (FIGURE II-107). Many of these elevations are in rows such as those near Novocherkassk. In addition, there are shallow, dish-shaped depressions (which in many places contain small, temporary lakes), numerous wide, flat, swampy valleys,

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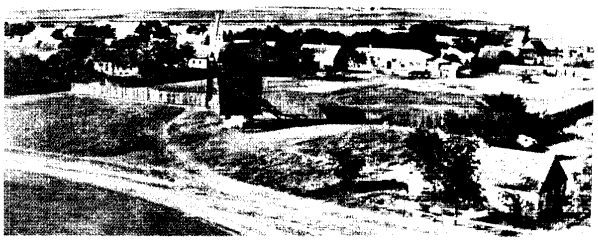

FIGURE II-106. *Eygenféld, north of Odessa.* Direction unknown. Terrain, buildings, roads, and trees (planted) are typical of the grassland plain along the Black Sea coast. Before 1941.

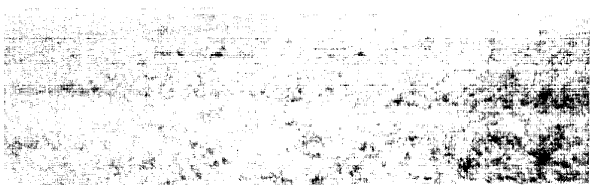

FIGURE II-107. *Grassland (steppe) east of Mariupol'.* Exact location not reported. Conical, granite hills, such as the one visible in the central background, are the only apparent relief features rising above the flat coastal plain. Before 1932.

and some coastal marshes. In places there are deep gullies. Only where spurs of the Central Uplands project into the area, however, are there any pronounced differences in the terrain just noted.

The Black Sea coast from the mouth of the Danube to the Dnestr is a low, marshy plain which is only slightly above sea level. This plain is interrupted by some shallow, salt lakes separated from the sea by narrow bars of sand. From the Dnestr as far as the Dnepr, the coast for the most part is steep with many precipitous clay bluffs (FIGURE II-108). Eastward from Odessa, however, the uniform appearance of the coast is broken by salt lakes which are separated from the sea by narrow ridges of sand, steep-sided gullies, and a few wide estuaries. Steep slopes and bluffs generally border the salt lake and estuary shores.

East of the Dnepr and along the Sea of Azov to Rostov-na-Donu the shore is low and bordered by numerous wide, flat sandbanks and sandspits. A short distance inland,

FIGURE II-108. *Coast of the Black Sea near Odessa.* Exact location not known. In most places the steep, coastal embankments are composed of loam and bordered by narrow, discontinuous beaches. The terrain inland is level- to gently-undulating. Before 1932.

FIGURE II-109. *Steep, loam coast along the Sea of Azov.* Exact location is unknown. View is typical of the greater part of the northwest coast of the Sea of Azov. Small crescent-shaped or ribbonlike narrow beaches lie at the foot of the steep slopes. Inland from the steep slopes the terrain is level to gently undulating. Before 1941.

and parallel to the coast there are clayey bluffs averaging about 100 feet in height. Narrow beaches lie along the shore at the foot of the slopes (FIGURE II-109). These beaches are wider wherever a river, minor stream, or ravine opens upon the sea. There are also extensive delta areas which contain numerous distributaries, abandoned channels, mud flats, and related formations at the mouths of the larger rivers such as the Dnestr, Dnepr, and Don. A few scattered swampy areas and salt marshes occur along the coast. For a detailed description of the coast itself, see Chapter IV, 43, A and D.

The wide, lower courses of several large rivers in the west constitute effective barriers to free movement because of their wide mouths and the fact that most of their valley floors are marshy throughout their entire width and are passable only when firmly frozen. It usually is possible to detour some of the salt lakes by moving along the narrow beaches which separate them from the sea. Otherwise movement is restricted to roads, dam aprons, or other constructions. River barriers are absent between the lower Dnepr and lower Don.

Northward the extensive coastal plain merges with the Southwest Russian Uplands (E-1b). Only between the Prut and the Dnestr rivers is a landscape change particularly noticeable. This change takes place just north of a line extending between Leovo (Leova) and Bendery (Tighina). Here north - south trending streams have cut flat-bottomed lowlands into the upland surface to depths of 150 feet or more. Upland or plateaulike surfaces of varying widths lie between these streams, whose valley sides are dissected by dry ravines and gulches. Inland, the upland surfaces of the interstream areas merge gradually with the hills of the Southwest Russian Uplands (C-2). Movement is channelized either along the main valleys or on the interstream steppe upland surfaces.

Eastward, between the Dnestr and the Dnepr, the terrain is less dissected and rises very gradually inland. For example, elevation increases from about 325 feet at Krivoy Rog to only 675 feet near Kirovograd (FIGURE II-110). Along the right bank of the Dnepr the steppe drops rather abruptly to the river but in places forms a hilly bank. Here and there along the Bug and Dnepr rivers, there are outcrops of granite, such as those near Konstantinovka on the Bug, Dnepropetrovsk on the Dnepr, and in the vicinity of Mariupol' (FIGURE II-111).

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FIGURE II-110. *Landscape near Krivoy Rog.*
Exact location not available. Vegetative cover gives very limited concealment from ground observation on this rolling steppe. Alinement of dwellings is typical of the grassland (steppe). 1930.

FIGURE II-111. *Granite outcrops near Mariupol'.*
Direction unknown. Terrain affords no natural cover or concealment. Shallow ravines and granite outcrops such as these along the Kal'mius river, however, offer some concealment. Before 1932.

Eastward from the Dnepr, the Dnepr-Donets Plain (PLAN 2, E-1c) extends almost to the watershed between the Donets and the Don. This plain lies less than 350 feet above sea level but is completely flat and featureless only along the Dnepr, where a strip of meadowland is flooded up to a width of 6 miles in the spring. Elevation increases very gradually northward and eastward to the watershed and then descends to the Don, the approximate eastern boundary of the Black Sea - Azov Grasslands. At Poltava, near the northern boundary of the subregion, the surface attains a height of only 500 feet, but retains its gently rolling character (FIGURE II-112). Although streams which cross the Dnepr Plain are in wide, shallow valleys and have divided the plain into many low and flat interstream elevations, the impression is one of a vast, rolling plain. As a rule, the right (west) banks and slopes of the valleys of the Dnepr's tributaries are somewhat steeper and higher

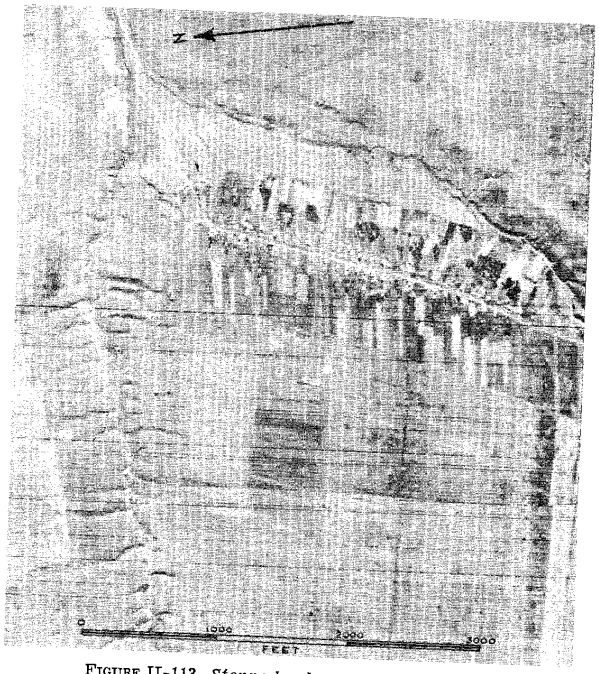

FIGURE II-113. *Steppe landscape east of Izyum.*
Air view of village alined along roadway in grasslands (steppe). Shallow gullies typical of this area are about the only sharp breaks in this undulating terrain. Note small garden patches behind each dwelling, in contrast to the extensive grain fields. July 1943.

FIGURE II-112. *Steppe plain near Poltava.*
Exact location is undetermined. Probably looking west across the northern border of the grassland (steppe) near Poltava. Scattered trees, more numerous than in true steppe, offer limited concealment. Road is typical of steppe regions. Note poor construction of buildings. 1945.

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FIGURE II-114. *Landscape east of Slavyansk.*
View shows gullied, high right bank of the Donets in contrast to the low left bank. Vegetation representative of most low-lying portions of valleys will afford some concealment. Low flood plain and gullied right banks (Donets Hills) restrict free movement. Lowland is easily crossed whenever surface materials are firmly frozen. August 1943.

than the left (east) banks where wide marshy meadows are located. Gullying is common throughout the area except in the watershed portions which consequently offer the best terrain for cross-country movement. Although gullied areas retard movement, they provide cover or concealment for small units in the otherwise unbroken, open terrain (FIGURE II-113).

To the southeast, the level Dnepr-Donets Plain ascends and merges with a much dissected, higher area, the Donets Hills, which are low and rounded (PLAN 2, E-1d). An irregular line drawn southward from Izyum on the Donets to about 25 miles north of Osipenko on the Sea of Azov, may serve as the western boundary between this hilly region and the lower-lying Dnepr plain to the west. To the north and east is the river Donets, along which are steep, badly gullied, and in places cliffed, rocky, limestone slopes, particularly eastward from Izyum (FIGURE II-114). Southward the Donets Hills merge with the Black Sea coastal plain without any emphasized boundary. Maximum elevation of the Donets Hills is about 1,200 feet above sea level a few miles west of Voroshilovgrad. The shallow, steep-sloped valleys, as well as wider valleys penetrating the broad

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FIGURE II-115. *Terrain in the Donets Hills.*
Looking north. West of Voroshilovgrad in the Donets Hills. Streams have cut deep, wide valleys into the upland surface. Most of the area is cultivated. Movement is favored along valley floors more than over the apparently almost level upland surface, for the gullies and ravines which have cut into the upland surface cause numerous local detours. June 1943.

level upland surfaces, together with local gullies in the Donets area give it a hilly appearance (FIGURE II-115). Cross-country movement is limited more or less to the valley floors.

The Don Steppes (PLAN 2, E-1e) extend eastward from the Donets Hills and slope up gradually to considerable elevations toward the great bend of the Don west of Stalingrad. Adjacent to the right bank of the river, particularly where the Don swings close to the Volga, this elevated plain descends abruptly and forms high, steep, earthen bluffs. A part of this area a few miles south of the Don, between its junction with the Khoper and its great southward turn, is above 600 feet in altitude. This higher part stands abruptly above the Don flood plain. Southward, the steppes extend to and beyond the border of this JANIS area and include the low Manych Depression with its chain of lakes.

The Don Steppes Region is a broad, apparently endless plain with but few scattered, elevated areas. Elevations are particularly lacking along the left bank of the Don. Eastward the land rises and merges almost imperceptibly with the Pre-Volga and Yergeni hills (about 328 feet above sea level) which overlook the Caspian Lowland. The descent to the river Volga and Caspian Lowland in the Volga-Caspian Desert Region (Region G), however, is abrupt. (See PLAN 11.) Streams crossing the area flow southward to the Sea of Azov or the river Don, like the larger rivers of the steppes, and form a relief peculiar to these steppe areas. The right banks of the watercourses in most places are steep, but their left banks are low and flat.

The river valleys, with the peculiar differences between their two banks, present more obstacles to movement from the east than from the west. To be sure the left (east)

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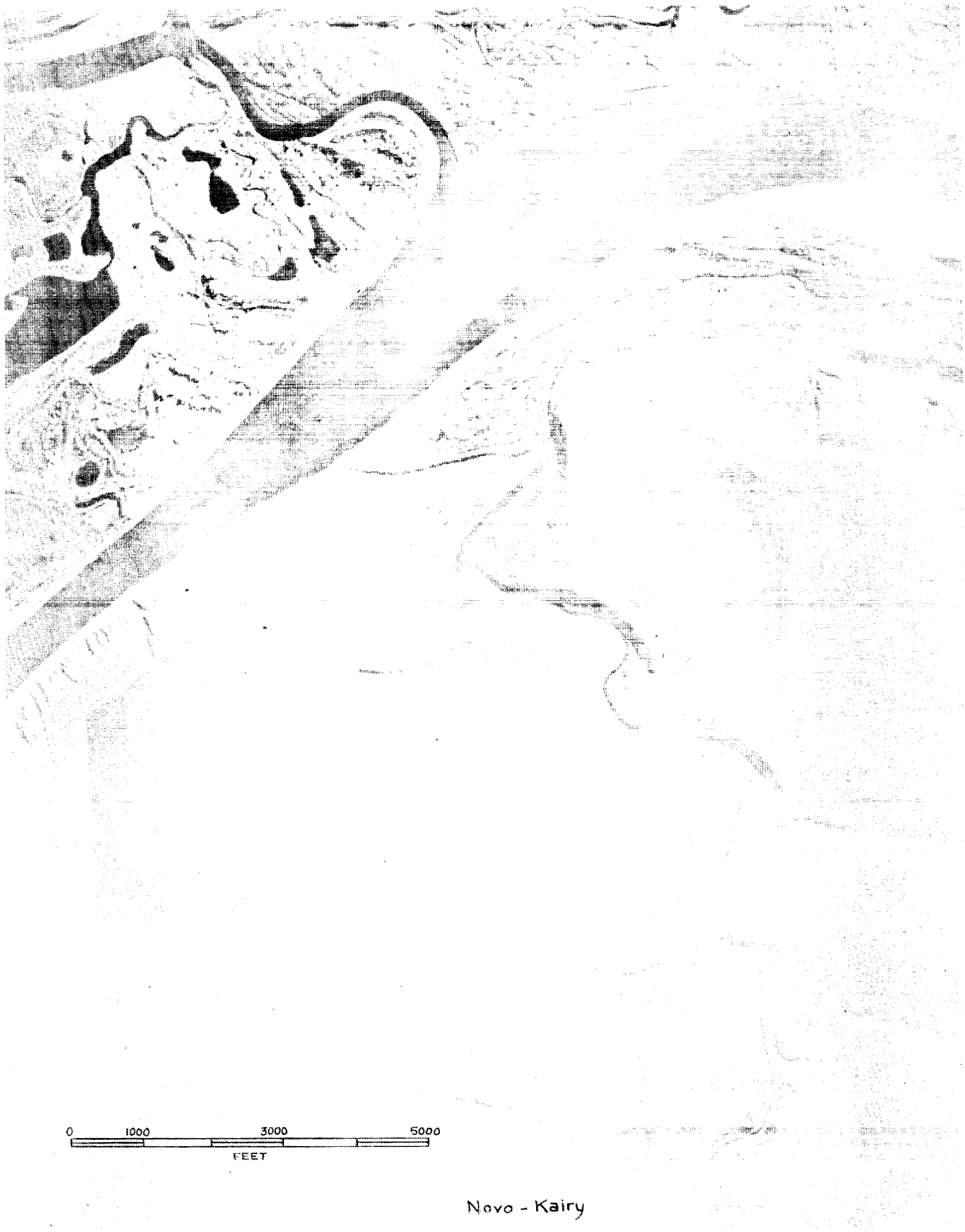

FIGURE II-116. *Lower Dnepr river near Kherson.*
Typical view of low swampy left (east) bank with numerous channels which are covered with water in flood time. Note high, abrupt, gullied right (west) bank. Roadways cross fields. Settlements are alined along main roadways. November 1943.

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bank of each river is low and may be marshy. An approach from the east requires scaling a steep, right bank (FIGURE II-116), but the terrain for miles westward is a plain which offers no obstacle, until another watercourse is encountered. On the other hand, if one approaches from the west through the Donets Hills, there would be an abrupt descent of about 230 feet to the river Donets, across which is a low, flat, marshy left bank and then a very gradual eastward rise to the right bank of the next stream where the descent to the valley floor is abrupt. This terrain pattern is repeated at each river crossing, and after a gradual ascent to a hilly bank overlooking the Don, the descent is again fairly abrupt to the Don.

On the whole, the terrain of the entire Black Sea - Azov Grassland Region is suitable for large-scale movement, the chief exception being along the steep right banks of streams. Here short, steep ravines and large deep gullies are obstacles to movement and in many places necessitate detours. The smooth-cropped land and pastures have been eroded by gullies which are not visible from a distance. The average length of these ravines and gullies in the Grassland Belt has been reported as about 0.3 mile and the average depth 33 to 66 feet. They are not as great a barrier here, as similar and larger landforms in the Black Soil Region in the Belt of Forest and Clearings (Region C).

(b) Drainage (PLAN 4).—Numerous large rivers and streams flow from north to south through the Black Sea - Azov Grassland at intervals of 60 to 150 miles. Minor streams also drain the area. From west to east the six largest of these rivers are the Prut, Dnestr, Yuzhnyy Bug, Dnepr, Donets, and Don. These larger southward-flowing rivers and streams handicap continuous east - west movement, and restrict and channelize movement. North - south movement also is greatly affected because of the change in trend of the lower courses of the larger streams. In addition, the wide, lower courses with marshy valley bottoms and estuary mouths are also obstacles. Crossings are more or less restricted to bridging points.

In general these southward-flowing rivers are frozen over for two months (mid-December to mid-February) in the western part of the Black Sea - Azov Grassland and for three months (mid-December to mid-March) in the eastern part.

1. PRUT.—The Prut, whose shallow valley ranges from 1.5 to 5 miles wide, has two high water periods. One lasts from 6 to 10 days sometime between mid-March and the beginning of May; and the second, a 10- to 20-day, high-water period occurs during June and/or July. The first rise is caused by spring thaws in the lowlands; the latter period is mainly due to the melting of snow in the Russian Carpathian Mountains. Knowledge of snow depths will aid in estimating the probable rise of the Prut. The Prut freezes over only during unusually cold winters and then usually between the latter part of December and the early part of February. The ice cover is seldom strong enough to bear the weight of most vehicles. That part of the river within the subregion is considered an obstacle to cross-country movement. Depth ranges from 6 to 12 feet and width from 180 to 300 feet. It is not fordable.

2. DNESTR.—From the northern border of the Grassland Belt to Tiraspol', the Dnestr follows a winding and rapidly descending course in a narrow, steep-sided valley, 400 to 500 feet below the general level of the land. Below Tiraspol' as far as its estuary mouth, a distance of 28 miles, the main body of the river passes for the most part through swampy depressions, but the river is braided, and in many parallel channels the water lies still. The principal high-water period comes in March and April, and a secondary rise comes about the end of June or the beginning of July. During both months the lower banks are overflowed to a considerable extent. The river freezes over entirely only during unusual and continued cold. Ice cover may support vehicles from the latter part of December to early February.

3. YUZHNYY BUG.—The Yuzhnyy Bug valley, within the Black Sea - Azov Grassland is for the most part narrow, with firm, steep slopes except for a short distance above Voznesensk, where the valley widens and forms a sandy basin. Here the stream is over 500 feet wide. Southward from Voznesensk the valley narrows for a short distance and then widens again. The valley floor is dry in places and swampy in others. Southward from Kovalevka, the valley floor is almost entirely occupied by the river or its estuary mouth. The river is about 4,000 feet wide at Nikolayev. Ice cover is usually continuous and firm from mid-December to the end of February, but it will support vehicles only during periods of continued severe cold. The estuary mouth also freezes over at times. Thaws occur rather frequently. Floods occur from early March to mid-April and often cover the entire valley floor up to a width of 1.5 miles. Sudden occurrence of high water is rare.

4. DNEPR.—That part of the river Dnepr within the Black Sea - Azov Grassland has channels so variable that any but the most recent maps or air photographs are likely to be erroneous. There are many parallel courses separated by islands and sandbanks. The Dnepr has a rocky bottom between Kremenchug and Dnepropetrovsk. There is a sand and gravel bottom with many sand islands from Dnepropetrovsk to Berislav. From Berislav to the river's estuarine mouth, which is 36 miles long and 4.5 to 9 miles wide; the bottom is muddy. The left bank below Kremenchug is for the most part low and flat, but swampy only in places. It was here that the Germans made their advance across the Dnepr. In places, as near Dnepropetrovsk, steep valley slopes form the right bank. The entire valley floor from Zaporozh'ye to the mouth is flooded, often to widths of 3 to 12 miles, from mid-March to the latter part of June; above Dnepropetrovsk from early January to early March. The river freezes over only during severe winters and then is not strong enough to support most vehicles.

5. DONETS.—The right bank of the Donets in many places rises 300 to 500 feet above the river. In a few places, such as south of Kamensk-Shakhtinskiy, the left bank also is steep and high. The river varies from about 200 to 550 feet in width, and 3 to 10 feet in depth. Floods are common in April and May. Ice covers the stream from mid-December to mid-March and usually is strong enough to support medium-sized vehicles.

6. DON.—The river Don south of Voronezh varies from a width of 825 to 1,150 feet in its upper course to 1,000 to 1,950 feet in its lower course. Depths vary from 3 to 40 feet. The course of the Don is winding, and the river has many parallel channels and backwaters, especially on its lower swampy course; the bottom for the most part is

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sandy. The right bank from Voronezh to Kalach is steep, 300 to 500 feet high, whereas the left bank is low and flat. From the beginning of April to early May the valley usually is flooded in places below Kalach to a width of 6 miles. From the Don - Chir junction to Rostov-na-Donu, swampy areas 2 to 10 miles wide appear alternately on either side of the river. From mid-December to mid-March, the stream is covered with ice, often 12 to 34 inches thick; it is thus strong enough to carry trucks and heavier vehicles. Navigation on the Don is conducted by shallow-draft steamers and barges south of Voronezh, but special engineering devices are necessary to maintain adequate depths.

In addition to the southward-flowing streams there are two large westward-flowing tributaries to the Don: the Sal and the Manych. The Sal is about 400 miles long; its width averages about 36 feet and its maximum depth is 10 feet. Low banks, numerous ponds, and salt marshes border the Sal. Ice forms from the end of November to mid-December and the break-up varies from early March to mid-April. Floods occur in the spring.

That part of the Manych Depression within the Black Sea - Azov Grassland formerly consisted of a series of connected shallow lakes bordered by salt marshes. It is now occupied by an irrigation system of regulated courses and three dams. The water backed up by the uppermost and largest dam forms Ozero Bol'shoy Manych. The size of the Manych system, including Ozero Bol'shoy Manych, depends upon the seasonal precipitation in the area and upon the volume of water transferred from the river Kuban' through a canal built about 1940 which leads into the Yegorlyk, an upper left tributary of the Manych.

As a rule, both river and lakes are frozen from the end of November or early December until the spring break-up, which occurs between early March and mid-April. In 1939, it was reported that the canal system was being expanded eastward through the Kuma Valley so as to connect the Caspian Sea with the Sea of Azov. The Manych Canal may be a major obstacle to cross-country movement by motorized units, for channel widths of 30 to 46 feet have been reported.

Water supply on the whole is plentiful near the large rivers. Deep wells are common and additional ones may be drilled almost anywhere. Many villages are located near gullies or ravines whose streams are dammed up to form ponds. Water, however, is scarce in late summer, particularly at a distance from the large rivers. At this season the water table lowers and small streams and shallow wells dry up.

(c) Vegetation.—Most of the steppes in Subregion E-1 (PLAN 2) are under cultivation and only relatively small remnants of the original vegetation are to be found. Two major types of natural vegetation remain in the Black Sea - Azov Grassland. In the northern portion of the steppes the dominant type is the feathergrass (*Stipa*), a hard-stalked, narrow-leaved, sod-forming grass, mixed with other plant forms such as varied types of herbs, bulbous plants, high weeds, and thistles. Growth ranges from 4 to 6 feet in height and offers limited concealment from ground observation (FIGURE II-117). The vegetation of the southern portion of the steppes consists of a combination of feathergrass and a fescue grass *(Stipa-Festuca)*, and a few other types of vegetation. In general, there are no trees

FIGURE II-117. *Feathergrass steppe near Voronezh.* Exact location not available. Typical feathergrass steppe with scattered islands of trees offer very limited concealment. Grasses usually have stiff, dry stalks, which make walking difficult and tiresome. Before 1932.

except where planted or where moisture favors natural growth, such as on valley terraces, within overflow areas of river bottoms, and along valley slopes (FIGURE II-118). Tree growths on the flood plains include sparse-to-medium stands of aspen, black poplar, and black alder, with oak, aspen, and maple on higher areas. Wooded sections do not present difficulty to motorized movement but do provide some concealment and cover. Flood plain meadows have abundant couch (quack) grass which is of considerable economic importance. Rush-reed stands are common along the lower courses of the Dnepr, Don, and Volga.

FIGURE II-118. *Low grass steppe near Mariupol'.* Exact location not reported. Trees, limited to the gullies (*balka*) of the region, break the monotony of this vast grassland area. Movement favored by gently rolling terrain. Gullies and vegetation provide limited concealment. Gullies may necessitate short detours. Before 1932.

Wheat is one of the principal crops in the Black Sea - Azov Grassland (FIGURE II-119). In the portion bordering the Black Sea, crops include cotton and rice (under irrigation), some maize, peanuts, sesame, and grain sorghum. Farther north, alfalfa, sainfoin (a forage crop belonging to the bean family), Sudan grass, winter rye, beets, carrots, soybeans, and barley are the most common. Eastward to the border of the Black Sea - Azov Grassland (Subregion E-1), the principal crops are spring wheat, rice, sunflowers, sweet clover, potatoes, and other vegetables. Truck crops are important near all centers of population. The vegetation of most of the subregion furnishes little cover and or concealment, except the limited amount in narrow groves near

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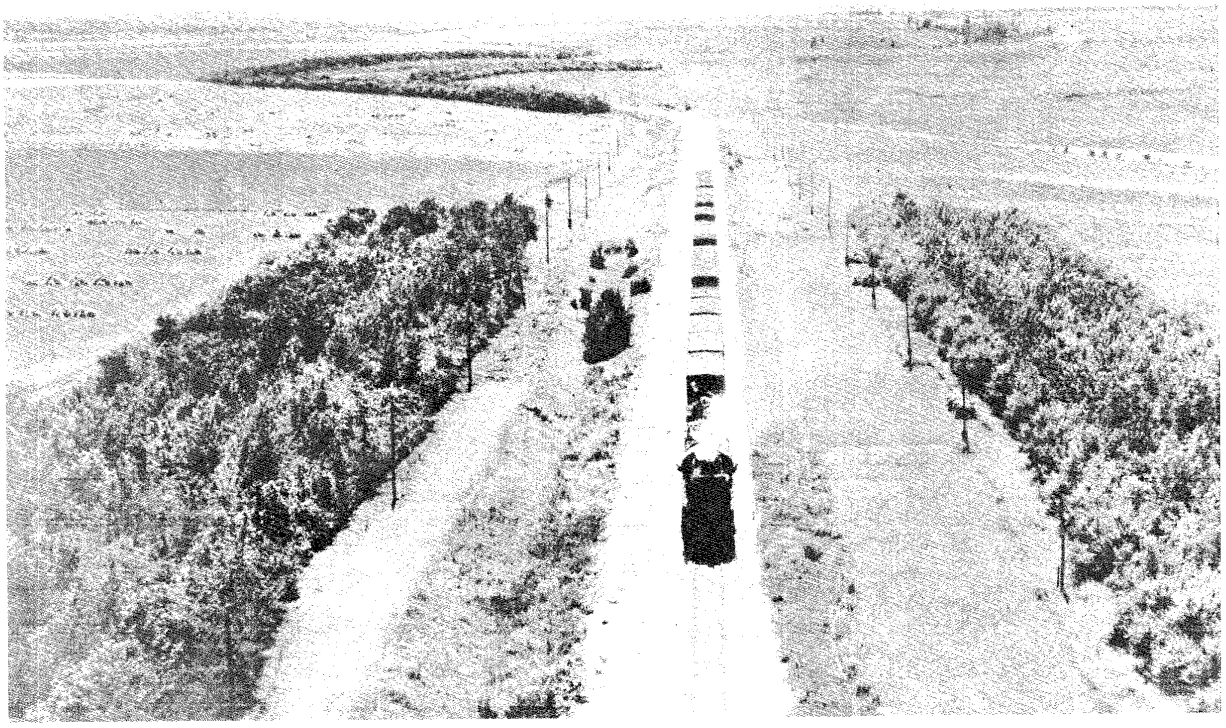

FIGURE II-119. *Steppe in vicinity of Poltava.*
Exact location unknown. View along winding railroad near Poltava. Undulating terrain representative of the grassland (steppe). Trees along right-of-way act as snow fences in winter. Elsewhere trees grow only where soils are moist in the ravines or gullies. Grain probably is winter wheat. Upper middle right slopes appear to be cut by gullies. 1945.

population centers, or along roads or railroads, in orchards, or along naturally wooded valley slopes (FIGURE II-120).

Low, sod-forming plant growths favor travel by wheeled and tracked vehicles off the road during dry seasons, but foot travel is especially wearisome because of the hardness of the dry, brittle stems of the various plants.

(d) Trafficability of surface materials (PLANS 6 to 10).—Cross-country movement is feasible over most of the gently rolling terrain of the Black Sea - Azov Grassland. Surface materials consist mainly of fine-textured, porous and permeable soils (black earths and loess), which drain rapidly under normal conditions. Such surface materials usually are trafficable but difficult to traverse during and immediately after heavy rains, and they become nontrafficable during the periods of spring thaw and of alternating rain and freeze-up in autumn. Less trafficable surface materials which extend along the coast and valley bottoms include clay loams, clays, and silts that drain less rapidly than the black earths and are nontrafficable for a considerable length of time after heavy rains. In addition there are alluvial materials and fresh and salt marsh areas, most of which are subject to flooding and are generally nontrafficable without special equipment except when deeply frozen (PLAN 4).

The most favorable season for cross-country movement is in winter, from late December to mid-February, when most surface materials are frozen firmly enough to support heavy vehicles (PLAN 9). Snow cover generally is thin and usually presents no hindrance to movement of tracked or wheeled vehicles even off roads, although local snow drifts may be encountered. Extensive cross-country movement also is possible in summer and early fall even though the precipitation maximum occurs during this time (PLANS 7 and 8). Conditions favorable to mud exist for only a short time during the rains and for a short period thereafter. Most rainfall comes in short showers, run-off is rapid, and the evaporation rate is high. At such times, movement is restricted locally. Continued rains, however, make most roads and fields impassable for a longer period. In addition, heavy rains or continued rains with resultant run-off cause streams to rise and thus reduces possibilities of over-all movement. Along the river flood plains, where there are numerous marshes and where the soil always is wet, movement at all seasons tends to follow the better drained, natural levees near the streams.

Numerous roads through the fields are readily passable in dry weather but are covered with much light, fine dust that rises in high, thick clouds and so marks all traffic movement. This fine dust is harmful to both machines and personnel.

Least favorable conditions for cross-country travel occur during spring (March-May) and late fall (mid-November) (PLANS 6 and 8), when there is alternate freezing and thawing of soils. Occasional mild winters tend to prolong this fall mud period. Of these two periods unfavorable for traffic, the spring break-up is by far the more severe because the spring rains fall upon soils that already are saturated with a winter accumulation of water, and where frozen, impervious subsoil slows internal drainage. Even improved roads may fail to support heavy traffic in places because of frost heaving.

The time from the onset of the first thaw to the beginning of steady melt conditions generally is 15 days. Steady melt

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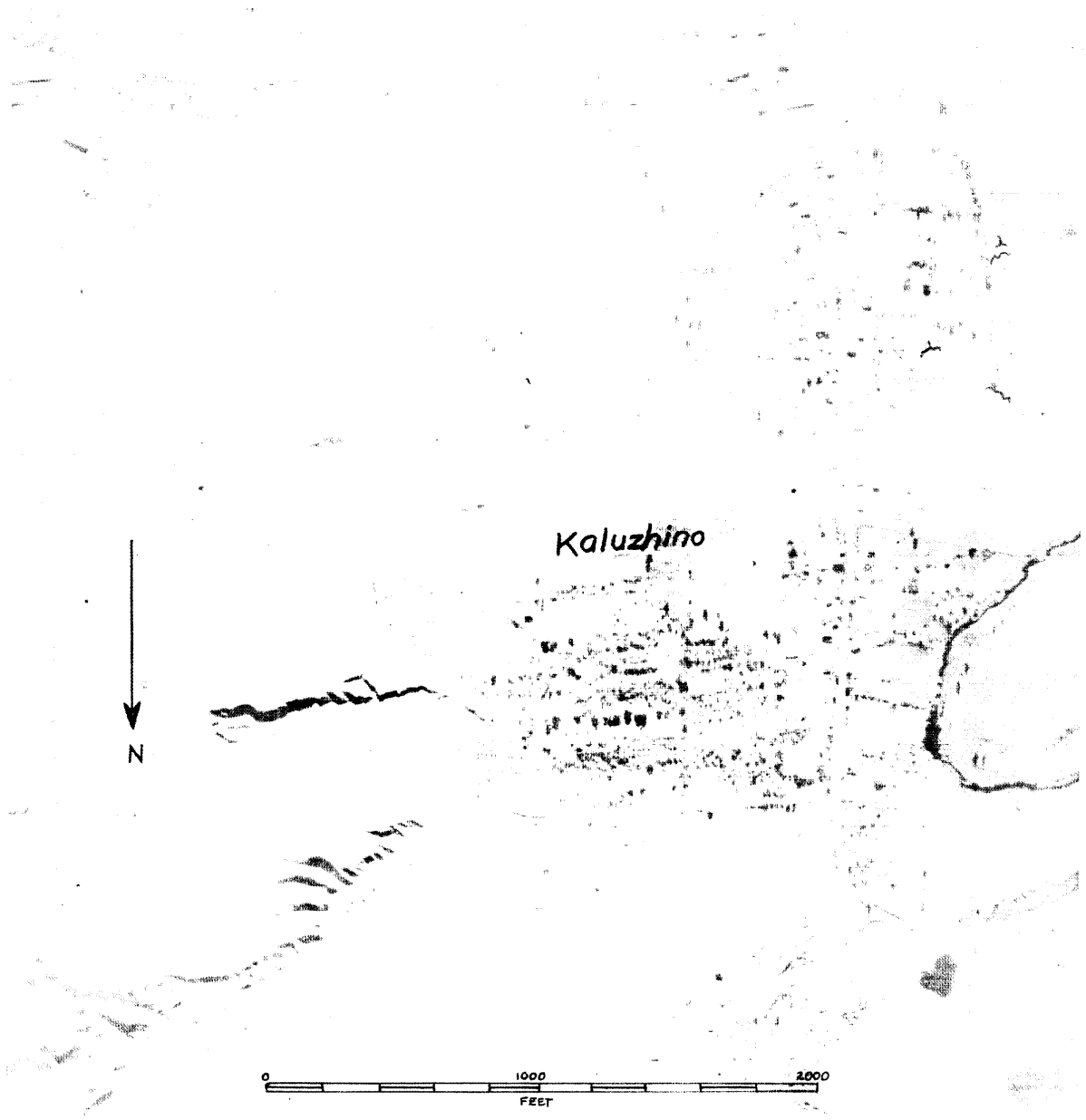

FIGURE II-120. *Vertical view of grasslands, about 35 miles southeast of Kremenchug.*
Village alinement and gullying typical of Russian grassland (steppe). Note field pattern, orchard development, and tree-lined roads. Gullies dissect the surface and with their headward extensions lend an undulating aspect to the terrain. Locally the gullies interfere with cross-country movement. November 1943.

conditions begin about 1 March in the region nearest the Black Sea (PLAN 6) and move slowly northeastward. The mud season occurs during March, April, or May and lasts from three to four weeks (PLAN 10). During this season traffic is either halted or restricted to main, hard-surfaced roads, because heavy vehicles form deep ruts in the tough, sticky mud on all unsurfaced roads.

During the spring and fall transition periods, however, heavy ground frosts of several days' duration or light overnight frosts favor cross-country movement during early morning hours when lighter vehicles can negotiate the slightly frozen terrain. (See PLANS 6 and 8 for 32° F. lines.)

(3) Subregion E-2, Khoper - Volga Grassland

(a) Relief (PLANS 2 and 3).—The Don - Khoper Plain (PLAN 2, E-2a) is part of a low, almost featureless plain lying between the Don and the Vorona-Khoper rivers and extending northward beyond this Grassland Belt (C-3c). This plain rises very gradually toward the east and merges with the Pre-Volga Hills (E-2b); elevations increase from 325 to 650 feet. Cross-country movement is particularly easy throughout this small area (E-2b) in that the soil is more sandy and the ravines and gullies common to much of the Grassland Belt are absent. South - north movement is preferable on the somewhat higher areas between the

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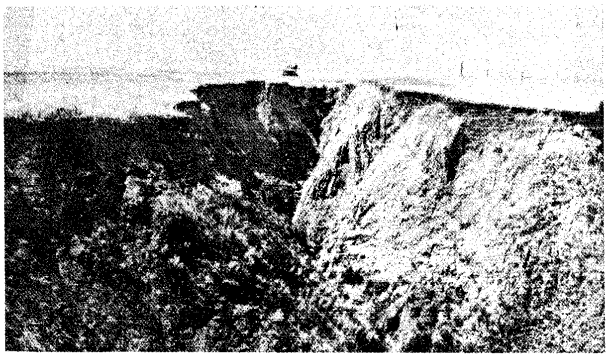

FIGURE II-121. *View of a typical gully near Saratov.*
Exact location not determined. This typical huge, steep-sided gully is eating headward into the fine-textured steppe soils near Saratov. Such gullies vary in length and depth but all are hindrances to rapid cross-country movement. They are not visible from any great distance by horizontal ground observation. Note short grass and gently undulating terrain in the background. Before 1941.

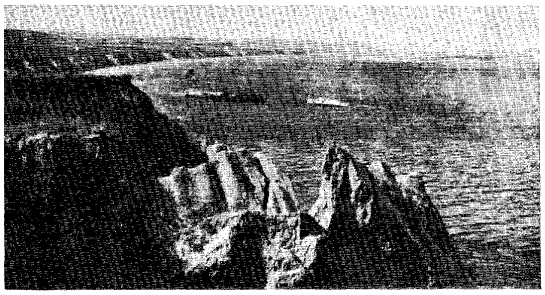

FIGURE II-122. *Volga bank below Saratov.*
Exact location not available. View shows typical high right (west) bank of the Volga and gullies cut into it. Short grass noted in middle left of picture is typical of the natural vegetation of the region. Before 1932.

streams. Limited concealment for small units is possible in the slightly lower valleys.

The Pre-Volga Hills (E-2b) between the Vorona-Khoper river and the Volga, form the watershed between the Don and Volga. This area is a gently undulating-to-hilly steppe with short, deep, dry, gullies and river valleys that give the surface a slight relief. These gullies, eroded into the flat surface, are not visible across a broad expanse of terrain, except from a short distance. Ravines and gullies are most numerous near and along the banks of the Volga (FIGURE II-121). Elevation gradually increases from the west and south then decreases abruptly on the east by a steep drop to the Volga (FIGURE II-122). The highest altitude, about 1,200 feet, is southwest of Saratov. Between Kamyshin and Stalingrad the highest point, about 24 miles southeast of Kamyshin, slightly exceeds 675 feet. The Pre-Volga Hills area narrows considerably to the south where the course of the Don nears that of the Volga. This narrow part of the hills provides the lowest, shortest, and easiest route across them; they can be crossed easily, even off the existing roads and paths, since ravine and gully detours are short. Movement from the west is feasible because of the very gradual slope of the terrain toward the east.

Along the left bank of the Volga, throughout the subregion as far south as Stalingrad, there is a wide strip of lowland, the Volga Lowland (PLAN 2, E-2c), which contains

FIGURE II-123. *A ferry-landing on the Volga.*
Opposite Nizhniy Balykley. This ferry landing utilizes a terrace below the high right (west) bank of the Volga. Such places indicate narrow and favorable crossing places, and usually give easy access to the upland surface. Note the construction of the camel carts common to the country bordering the Volga; note also the high west bank in the abckground. Before 1941.

meadows several miles wide, subject to flooding. In some places along the right bank, a narrow terrace extends along the river, between it and the steep slope to the upland (FIGURE II-123). The entire lowland along the river is impassable in spring, and even summer travel is difficult in such places as between Kuybyshev and Syzran', because of the low-lying terrain with its numerous lakes. Low, dry swells, however, between these poorly drained sections make circuitous movement possible. Eastward from the Volga, the terrain ascends by a series of clearly distinguishable terraces and merges with a gently undulating, clayey grassland, the Trans-Volga Hills (PLAN 2, E-2d). The lowest of these terraces is about 30 feet high and 15 feet wide. The Trans-Volga Hills extend to and beyond the borders of the area included in this JANIS.

For example, about 30 miles east of the Volga, elevations increase from about 300 feet to more than 650 feet near the eastern border of the Khoper-Volga Grassland. Here higher areas are almost flat, and form low tablelands with rounded edges. Gullies are cut into these low tablelands near the Volga (FIGURE II-124).

On the whole, the subregion is suitable for mechanized cross-country movement except where swamp-bordered streams limit travel.

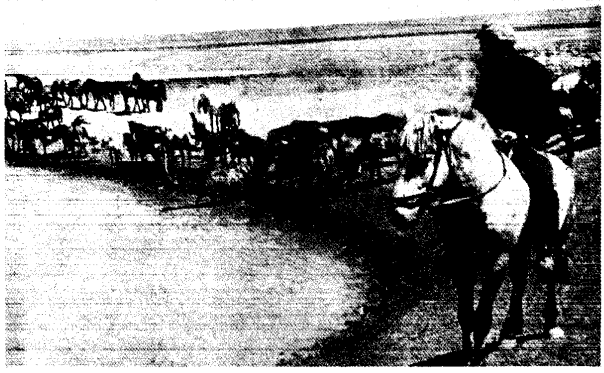

FIGURE II-124. *Upland area south of Kuybyshev.*
Exact location not available. This portion of the Khoper-Volga Grassland is used for raising livestock. Water hole at lower left. Long, deep gullies, noted in the background, break the landscape and retard cross-country movement, necessitating detours. Before 1945.

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(b) Drainage (PLAN 4).—The Khoper-Volga Grassland contains fewer streams than the Black Sea - Azov Grassland to the west. The major streams lie west of the Volga and flow from north to south whereas minor, narrow, shallow streams are east of the Volga and flow from east to west.

The Khoper river, in the Khoper-Volga Grassland, has a steep-sided right bank from Bekovo to its junction with the Don. Between Bekovo and Balashov the Khoper is from 65 to 100 feet in width but attains 325 feet south of Borisoglebsk. Depth varies greatly in this river of the dry steppe; variation both locally and seasonally is between 1 and 6 feet in its upper course and between 1 and 16 feet in its lower course. The stream bed contains numerous sandbanks. Highest water occurs during the spring. The river is ice covered from mid-November to the end of March or early April.

From Petrovsk (northwest of Saratov) to a point west of Stalingrad, the wooded winding valley of the Medveditsa, which is swampy in many places, is approximately 50 miles west of the Volga. Stream breadth varies from 100 feet near Petrovsk to 425 feet near its confluence with the Don, and depth ranges from about 2 to 6 feet near Petrovsk and to 14 feet in its lower course. Ice cover on this river lasts from mid-November to early April. The high-water period occurs in the spring.

West of the Volga, the winding, tree-lined Ilovlya roughly parallels the Volga at a distance of 20 to 40 miles. Breadth of the Ilovlya varies from 1.5 to 7 feet. Its bottom is muddy in its upper course, but sandy in the lower course. In places, however, the bottom is stony. High-water season is in the spring.

Although only a small portion of the Volga lies within this subregion, the river's breadth here varies from 1,650 feet near Syzran' to 7,200 feet near Saratov and Stalingrad. Depth is always at least 9 feet in the main channel, but may range from as little as 4 feet over the numerous sandbars to 40 feet in deeper portions of the channel. Velocity increases gradually from 1.6 feet per second in the north to 8 feet per second below Saratov. Velocity in high water periods may increase to more than 10 feet per second near Saratov. The right (west) bank of the Volga appears mountainlike as it rises abruptly to 650 feet and in places to almost 1,000 feet, but the left bank is generally flat. High water (up to 45 feet) occurs from the latter part of April to the beginning of June. Overflow often creates a lakelike river up to 12 miles wide. The stream is ice covered from early December to mid-April at Kuybyshev, and from mid-December to early April at Stalingrad. Ice should be firm enough to support heavy vehicles.

East of the Volga, streams flow westward. The orientation of these streams makes them more serious barriers to north - south movement than east - west movement. They have marshy borders.

(c) Vegetation (PLAN 5).—The natural vegetation of the Khoper-Volga Grassland is similar to that of the Black Sea - Azov Grassland but differs in that natural grasses are shorter and grow more sparsely, leaving more ground uncovered. Today the whole region is predominantly agricultural, or pastoral, with only scattered spots of natural vegetation (FIGURE II-125). Much of the area is utilized as pastureland (FIGURE II-126). Crops produced within the more moist and irrigated sections of the subregion include spring wheat, truck crops, sunflowers, tobacco, and others (FIGURES II-127 and II-128). The natural grasses and the low-growing crops produced within the region provide no natural concealment. The few wooded areas along the rivers and on lower portions of valley slopes furnish some cover and concealment. On the level steppe surface concealment is difficult by day, hence night movement is favored.

FIGURE II-125. *Ox team in the Khoper-Volga Grassland.* View is representative of spring season when farmers go to distant fields and remain there until fields have been seeded. The level terrain covered with short grasses favors cross-country travel. However, mud formed by rains, spring thaws, and the alternating freezing and thawing periods in autumn often stops all cross-country movement. Before 1941.

FIGURE II-126. *Cattle grazing on the Khoper-Volga Grassland.* Exact location not determined. Extensive, level, open grasslands east of the Volga contain no major natural obstacle to movement. Note low cover of grass and weeds. Before 1942.

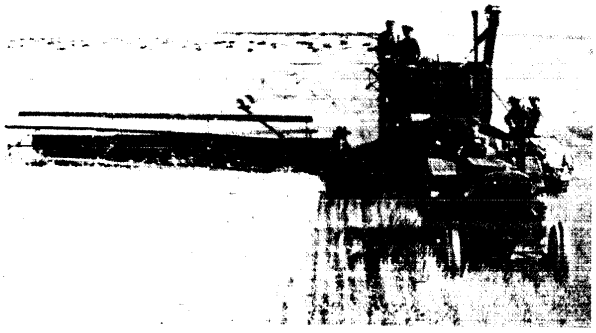

FIGURE II-127. *Harvesting wheat near the Don.* Exact location not available. Broad, cultivated plains and fertile soils in the grasslands have led to extensive mechanized farming. Wheat is the dominant crop. Movement is possible but concealment is limited. Before 1945.

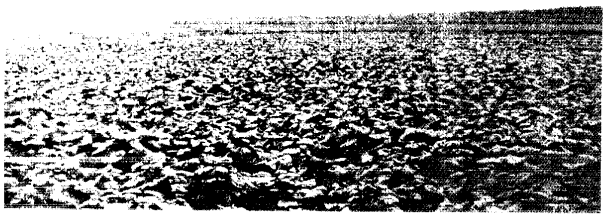

FIGURE II-128. *Tobacco field in the Khoper-Volga Subregion.* View south of Marks (Marksshtadt). Extensive tobacco fields in the foreground cover much of the gently undulating terrain. Such extensive fields become muddy and permit little traffic over them whenever the soils are wet. Before 1941.

(d) Trafficability of surface materials (PLANS 6 to 10).—Cross-country movement is relatively easy over the level-to-rolling, grassy Khoper-Volga Grassland. Soils for the most part are fine textured, drain rather slowly, and generally are nontrafficable during wet seasons and for a considerable length of time after heavy rains. The wettest month at Saratov is June and the driest is March. (See Chapter V, 54, A.) Sandy soils which normally drain rapidly lie in scattered areas along the Don and Khoper rivers. Sands are most trafficable when moist but not waterlogged. Most of the sandy areas in the Khoper-Volga Grassland are low-lying, have a high watertable, and ordinarily are associated with swampland; hence they are relatively impassable during wet weather except along low ridges which extend through them. Alluvial soils on the flood plains along the Volga are always wet and are trafficable only when frozen (PLAN 9) or when special equipment is used.

The most favorable season for cross-country movement occurs in late summer, July through October, when high summer temperatures and relatively low rainfall thoroughly dry out the surface materials. A second favorable season occurs in winter, December through February, when most surface materials are deeply frozen (PLAN 9). Much dust in summer, however, hinders movement by affecting mechanized units and personnel and by setting up easily observed dust clouds. Snow affects traffic only locally wherever drifts occur. Mechanized equipment and personnel must be prepared for cold weather.

Least favorable surface conditions are encountered during the period between the time when the snows melt and soils thaw and when the soils dry out. Melting of the snow begins about mid-March (PLAN 6). During this dominantly muddy period (PLAN 10) wheeled vehicles sink to the axles on unsurfaced roads or fields. Even tracked vehicles bog down. The spring mud season is most prolonged between Voronezh and Saratov. Ground dries out toward mid-April, but flooding of rivers continues into June. Of all flood plains, the wide flood plain of the Volga is the greatest barrier to movement. A secondary mud season occurs in late autumn (October through November) between the fall of the first snow and the onset of continued freezing temperature (PLAN 8). During both seasons, however, the freezing over of surface materials at night will often permit limited movement in early morning hours, but there is usually a delaying effect because of frozen ruts, detrimental especially to wheeled vehicles and to some extent to tracked vehicles.

(4) Subregion E-3, North Crimean Grassland

(a) Relief (PLAN 2, E-3).—Southward from the main grassland of southern Russia and connected with it by the Perekop Isthmus lies the monotonously level, low-lying North Crimean Grassland of the northern and middle portion of the Crimean Peninsula (FIGURES II-129 and II-130). The grassland, a continuation of the great steppe or Black Sea - Azov Grassland of Russia, extends about 200 miles from west to east. This grassland occupies about three-fourths of the total land area of the Crimea and has a mean altitude of about 80 feet. Elevation of the plain increases gradually from the low, level plain in the north and merges with more elevated portions westward and southward. There is no obstacle to mechanized movement, once the rounded edge of the low bluffs near the coast is scaled.

FIGURE II-129. *Grassland landscape of Northern Crimea.* Exact location not reported. View is representative of the dry northern portion of the Crimea. Level terrain, covered with scant, low bunch grasses, is well suited to rapid movement. Watering places at wells, such as the one shown here, are typical of Crimea. Wells are usually deep. Before 1940.

Westward an extension of this plain juts far out into the Black Sea as an elevated "bank" (*val*), which is higher than the main steppe area and forms the plateaulike Tarkhankutskiy Poluostrov which terminates in a steep bluff coast. Valleys of dry stream beds and small gulches or gorges which are 30 feet or more deep are more prevalent on the Tarkhankutskiy Poluostrov (peninsula) particularly west and south of Chernomorskaye (Ak-Mechet') than in any other portion of the subregion (FIGURE II-131). Although these areas restrict movement locally, they are not considered major obstacles to movement, as they can be avoided without long detours. In places limestone outcrops appear.

Eastward from the main part of the plain the drier Kerch Peninsula extends between the Sea of Azov and the Black Sea. The surface of the peninsula is for the most part gently-rolling-to-hilly but monotonously flat in the southwest. The most varied relief is in the northeastern part, where low, narrow, discontinuous, east - west trending limestone ridges and hills form low, plateaulike areas with gently rounded tops, producing a rather sharply dissected hill landscape. Elevations of the ridges are as much as 400 or 500 feet above sea level. Although they drop off rather abruptly on their margins, they are not major obstacles to movement. These ridges furnish advantageous observation sites (FIGURE II-132). The highest elevation (about 550 feet) lies northwest of the city of Kerch'. In places limestone outcrops from the ridges form small, jagged, rocky summits.

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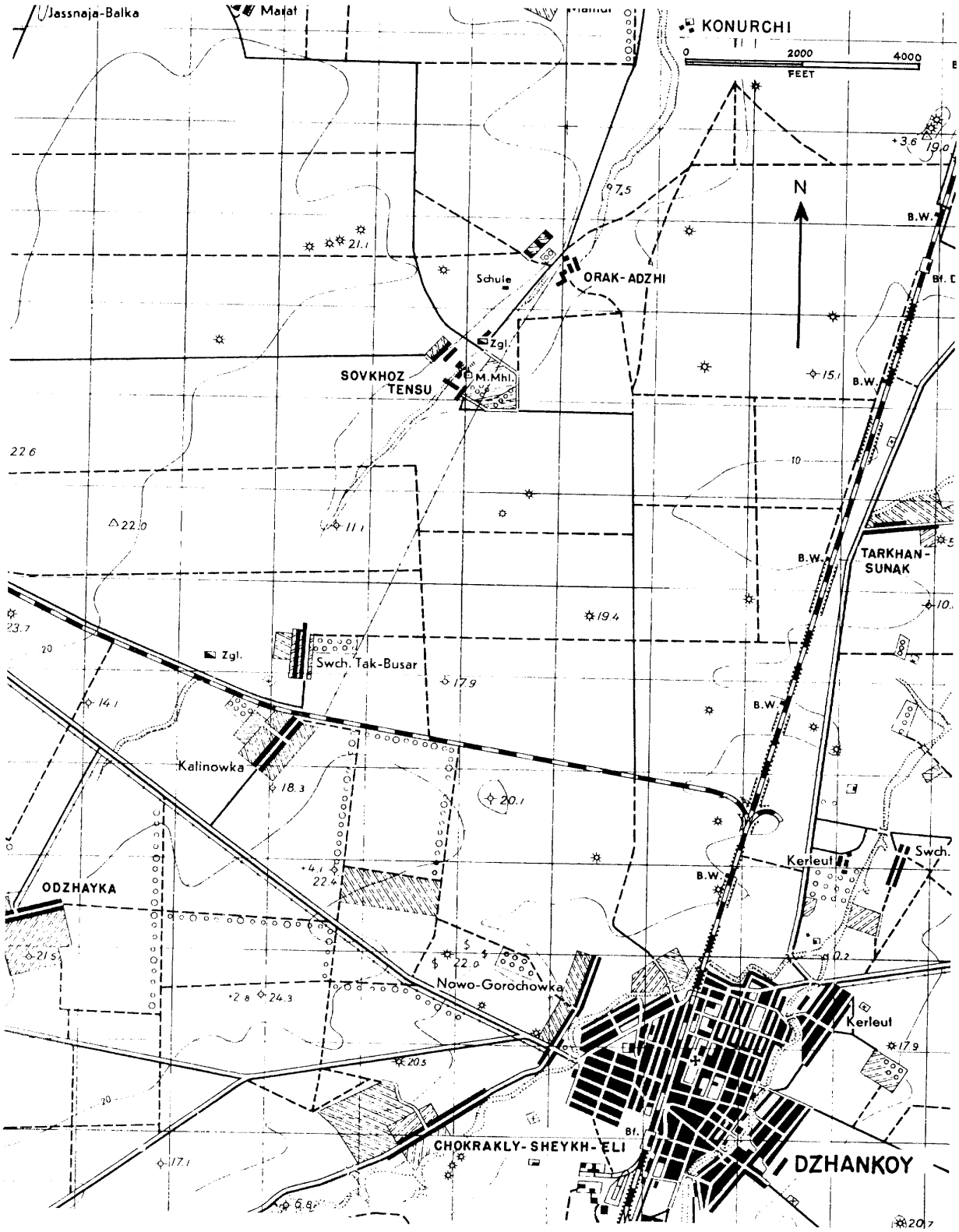

FIGURE II-130. *Portion of topographic sheet covering Dzhankoy.*
Dzhankoy, in Northern Crimea. Contour interval 10 meters. Characteristic terrain and settlement pattern in northern Crimean steppes. Flat land, cultivated garden plots, road grid, and narrow, usually dry stream beds are typical of the steppe of Crimea. Railroad embankments and narrow V-shaped gullies 3 to 15 feet deep are the only apparent obstacles to movement in this steppe area. Shaded areas are garden plots; circles are trees, possibly orchards; $ indicates vineyards. 1943.

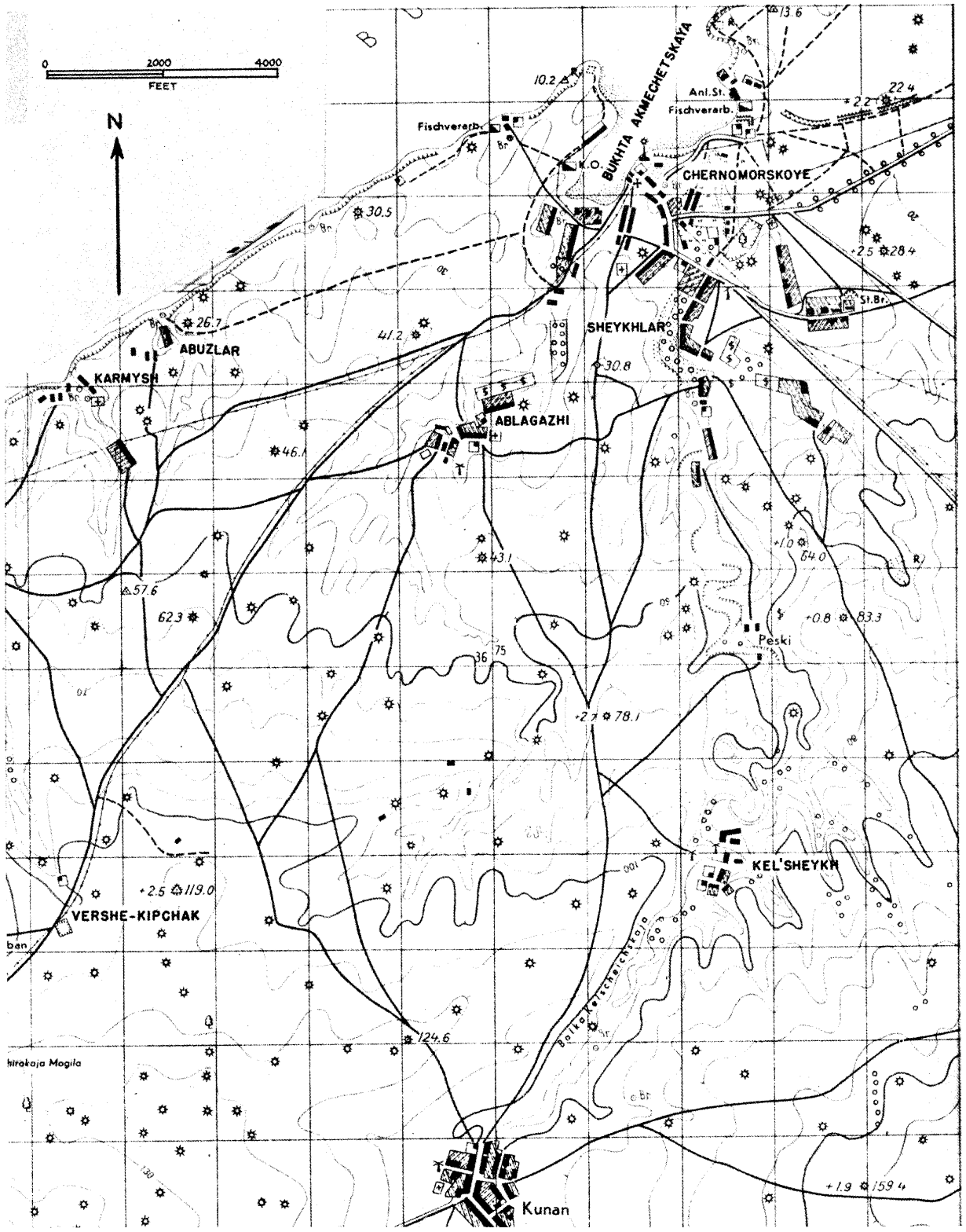

FIGURE II-131. *Section of topographic sheet showing area in vicinity of Chernomorskoye (Ak-Mechet').*
Contour interval 10 meters. Terrain is more dissected in this portion of the Crimea than on Figure II-130. The *balka* (gully) south of Chernomorskoye (Ak-Mechet') is the longest one on the Tarkhankutskiy Poluostrov (Tarkhankut Peninsula) and affects east-west movement. Note roads follow low gradients. The steep coast is typical of much of the Crimean coast. Note garden patches around settlements. 1943.

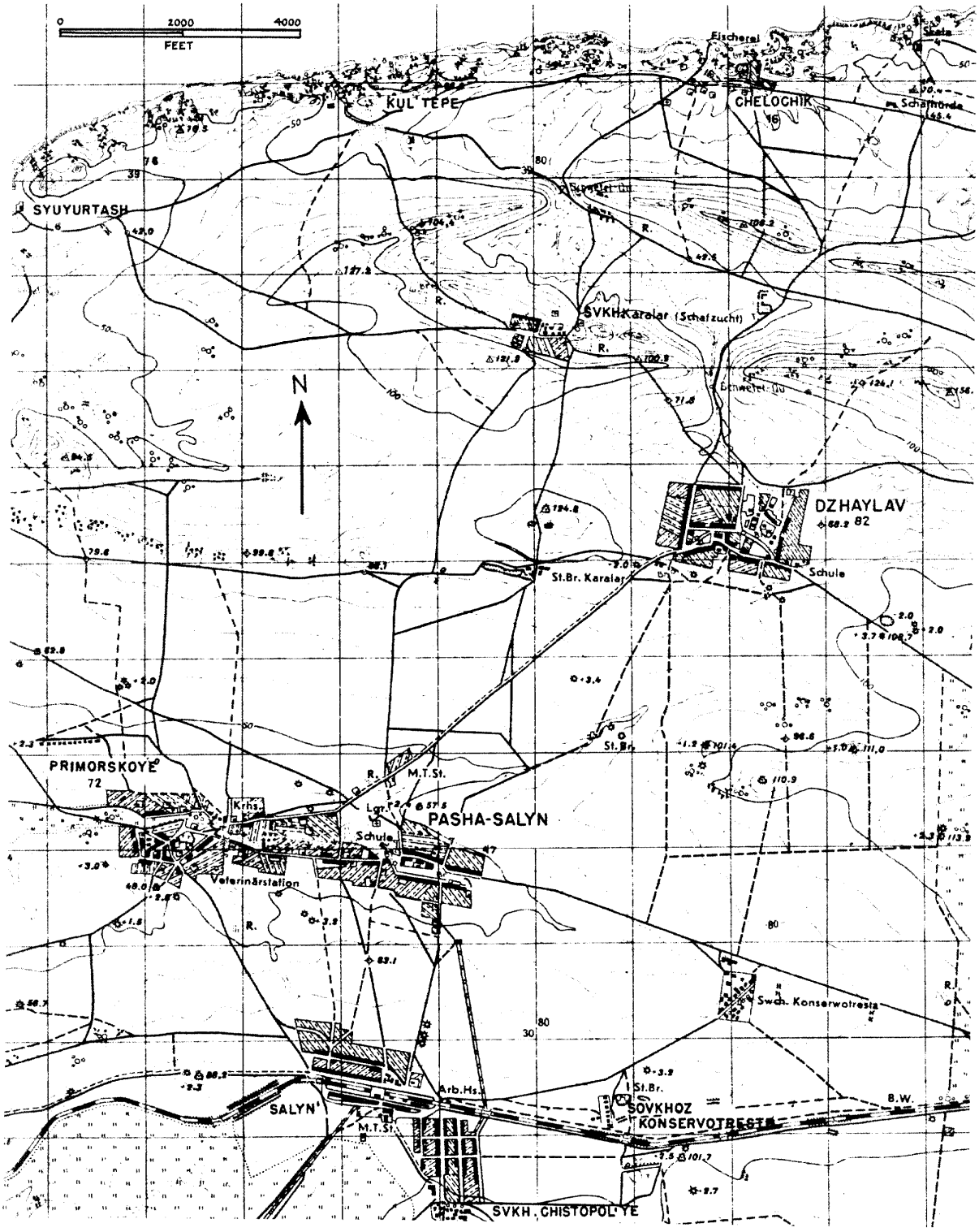

FIGURE II-132. *Portion of Primorskoye topographic sheet.*
Contour interval 10 meters. Map shows gradual slope near Primorskoye in contrast to ridge area in northwest and is typical of northern Kerch Peninsula of the Crimea. Ridges are low, narrow and discontinuous. Although not major obstacles to movement, the ridges channelize movement and could be used as observation posts. Note steep-cliffed north coast, rocky in places. Railroad in southern part is a portion of main line from the Ukraine to Kerch'. 1943.

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Gulfs, such as Zaliv (Gulf) Karkinitskiy, numerous salt lakes of the estuary type, and the Sivash indent the northern coasts of the Crimea (FIGURE II-133). The coasts of the Tarkhankutskiy and Kerch peninsulas have narrow beaches 300 to 600 feet wide, backed by slopes of loamy soil up to 30 feet high which have not been seriously eroded. From these slopes there is a gradual rise inland to the general plain level (FIGURES II-131 and II-132). Elsewhere within the subregion a low coast is bordered by sandspits, hooks, and sand bars and the elevation gradually increases inland.

FIGURE II-133. *View of the Sivash.*
Exact location not known. Low-lying marshy coast bordering the Sivash has low, scant, salt-tolerant vegetation. Movement is limited to dry season or period of frozen soils. Before 1940.

The level terrain of the subregion favors extensive agriculture of mechanized type. Farmers must rely almost entirely, however, upon artesian or other type wells, or upon the meager precipitation to moisten the soil.

The numerous scattered farm groups throughout the subregion, with their earth and rock wall structures, lend variety to the otherwise almost featureless landscape. Other man-made structures of topographic importance include the old earthen walls (Tatar Walls) at two entrances to the Crimea: at Perekop and middle Kerch Point. They are 36 feet high and 24 feet wide at Perekop and 24 feet high by 18 feet wide on the Kerch and do much to channelize movement.

(b) Drainage (PLAN 4).—There are few streams within the North Crimean Grassland. Most of them rise in the mountainous area on the south (Region F - Mountainous Crimea); some flow northwestward but the majority northeastward, either as large brooks or small rivers. Most are intermittent, drying up in summer, and are temporary barriers only during the melting of snows in the mountains in the spring or after heavy rainstorms. The sandy bottoms shift often, and these streams flood dangerously. During most of the year they can be crossed readily. The few swampy places along the rivers can be avoided easily.

The only stream of any length which crosses the North Crimean Grassland is the feeble Salgir and its few minor tributaries. Even it is not a significant barrier and is too shallow for navigation. The width of the Salgir averages from 52 to 66 feet and its depth is only about 2 feet. In summer, however, the river is much lower, for it loses most of its water by evaporation and gains very little, due to the low precipitation. The stream bed often is completely dry along the lower part of its course.

The salt lakes in this subregion are clustered mainly in the following groups: 1) the Yevpatoriya group, 2) the Perekop, and 3) the Kerch'. The lakes are for the most part very shallow, with the exception of the long Ozero Donuzlav which is up to 80 feet deep. Prolonged droughts transform the shallow water bodies into masses of grayish, foul-smelling mud.

Lakes, and other water bodies within the area are barriers to movement. For example, the body of salt water between the Perekop Narrows and the narrow tongue of the Arabatskaya Strelka is so shallow that it can be crossed here and there by horse-drawn vehicles and foot traffic but a persistent wind from open water may change the water-level somewhat from time to time. The Sivash is a major barrier for movement of any kind because of its soft bottom. The Russians, however, did cross the Sivash in the spring of 1944 on earthen causeways constructed for the purpose. Salt marshes also are common along the northern bar-locked portions of the coast, on the Kerch Peninsula, and northeast of Feodosiya.

All water bodies usually have some ice from the end of December to the middle of March but freeze over completely only during very cold winters. The straits at Kerch' and the Sivash likewise freeze only in very cold winters, such as that of 1941-42 (during January), when traffic was possible over the ice in Kerch Strait.

Adequate supplies of potable water are difficult to find in the subregion because of the low water table, scant rainfall, and alkaline soils. Since streams are few, the only surface water is that collected in pools from melting snows or summer showers. In most places the inhabitants of the subregion must rely upon cisterns or deep wells (usually artesian) for their daily water supply, as well as to irrigate their crops. Most of the wells contain water that is slightly brackish or alkaline. Generally speaking, the location and size of the settlements represent the availability of water with fair accuracy. Water is apt to be scarce in all seasons on the Kerch Peninsula.

Cross-country movement is easy in the North Crimean Grassland because of the extensive areas of gentle slopes and the scarcity of river valleys. The only places which are obstacles to such movement are the gullied area of the Tarkhankutskiy peninsula, portions of the ridge and valley section of the Kerch peninsula, and the coastal marshes and swamplands.

(c) Vegetation (PLAN 5).—Vegetation of the North Crimean Grassland is similar to that of all the Grassland Belt. The lowest, northeastern part, adjoining the Sivash, has much saltmarsh vegetation and sagebrush. In the south and west, the chestnut and black-earth soils are sparsely covered with short grass and shrubs.

On the Kerch Peninsula there is a definite transition from a dry, semiarid feathergrass-wormwood and wormwood steppe to semi-desert wormwood saltwort with its stunted shrubs. Most of the northern part of the Kerch Peninsula is covered with a mixed growth of wormwood, feathergrass, and various herbs. Owing to the alkalinity of the soil; however, its southwestern district, like the land around the Sivash, presents a semidesert landscape dominated by wormwood and saltwort. Isolated sections of stiff, hairy or thorny, low shrubs (*frigana*) are found in coastal areas, on stony slopes of gullies and ravines, on more elevated stony sections of the plain, and on the more moist, north-facing slopes.

Vegetation does not offer any major obstacle to movement of wheeled or tracked vehicles. Most of the subregion is cultivated farmland with numerous wheat, barley, and tobacco fields. Wherever the land is not cultivated, it is covered with short native grass and utilized as pasture. The extent of cropland and cultivated area, together with the gentle grass-covered slopes, makes it possible for tracked vehicles to maneuver quite readily in this region.

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There is a definite lack of natural means of concealment; hence night movement is favored. The few planted trees, usually poplars, found on the edges of villages offer no concealment.

(d) Trafficability of surface materials (PLANS 6 to 10).—The level-to-gently-rolling terrain of the North Crimean Grassland is very favorable for all types of extensive cross-country movement. Surface materials consist mainly of fine-textured loams, clay loams, or silty clay materials with fair-to-slow drainage under normal conditions. Except for the spring and fall mud periods or after heavy showers, materials are trafficable throughout the year. Closely associated poorly and well-drained material and numerous salt marshes with alkaline soils cover the northern portion of the subregion. On these closely associated materials movement is stopped for about 10 weeks (early March to June) during the spring thaws and rains. The best time for traffic on these soils is in late summer, but even then trafficability is periodically poor and fair, because these areas become slippery with the slightest rainfall. The better-drained, sandy soils usually are most trafficable when damp or wet. Such soils as those on the Arabatskaya Strelka and in the dune areas near Yevpatoriya, Chernomorskaye (Ak-Mechet'), and Feodosiya, however, are least trafficable during the latter part of March and early April, when numerous local inclusions of fine-textured soils become waterlogged.

In general, the most favored period for large-scale movement is during the summer, when most of the surface is dry (PLAN 7). January and February are also favorable for movement when the surface materials are apt to be frozen (PLAN 9). Often in winter cold and warm periods alternate. During such periods, alternate freezing and thawing, together with rainfall, may develop almost bottomless, muddy roads overnight. Snow cover is practically nonexistent.

Least favorable periods of trafficability are during the spring mud period, from the end of February to the end of March, and the fall - early-winter mud period from the middle of November to the end of December (PLANS 6 to 10). Saturated soil conditions accompany thawing and freezing and rainfall and cause widespread poor-to-impassable conditions. During World War II it was observed that traffic on dirt roads could be continued only if the roads were maintained and separate routes assigned to tracked vehicles and wheeled vehicles.

F. Region F, Mountainous Crimea

(1) Introduction (PLANS 2 and 3)

Mountainous Crimea is located in the southern part of the Crimean Peninsula and extends along the southern coast from the city of Sevastopol' in the west to the city of Feodosiya in the east. It covers a belt about 100 miles long and as much as 35 miles wide. The region has an area of about 3,000 square miles, or 50% more than the State of Delaware.

Sevastopol', one of European USSR's great naval-base - fortresses, is located on the west coast of the region. By air, Sevastopol' is about 310 miles from Ankara (Angora), Turkey, about 340 miles from Istanbul, Turkey, and only about 350 miles from Bucharest, Rumania. Major industrial and agricultural areas of the Ukraine are near. For example, Odessa is about 185 miles by sea or air from Sevastopol'; Zaporozh'ye, about 230 miles by air; and Rostov-na-Donu, about 330 miles by air. In addition, Zaporozh'ye lies about 200 miles by air from Simferopol', and Rostov-na-Donu is about 250 miles by air from Feodosiya. From Sevastopol' a railroad runs northward to Moscow. It passes through the cities of Simferopol', Zaporozh'ye, Khar'kov, Kursk, Orël, and Tula.

The low mountainous relief of the region contrasts strikingly with the plain of the northern portion of the Crimean Peninsula and the Ukraine in Region E. The Main Range, which in the west is a chain of plateaus and in the east is a group of branching ranges, extends along the south coast. The range has an average elevation of 2,000 to 4,000 feet, and the highest peaks are over 5,000 feet.

The south side of the Main Range is very steep, and a series of steeply sloping steps and ridges descend to the precipitous and rocky Black Sea coast. Relatively level areas along the coast are limited to a few small, terraced river valleys and basins separated from each other by mountain spurs. The northern slope is considerably less steep than the south slope.

The steep slopes of the mountainous terrain limit movement to a few valleys, basins, and plateaus. The Main Range can be crossed by vehicles only over roads which are more numerous in the more highly developed west than in the east. There are few passes in the western section, and those that do exist are 2,000 to 3,000 feet above sea level. In the lower, eastern section the passes are at elevations of 1,000 to 2,000 feet above sea level. Steep grades and many sharp curves characterize the approaches to the passes.

Beyond the northern slope of the Main Range is a foothill zone containing two major ridges (the Inner and Outer Ridges) having precipitous southern slopes and gently sloping, but deeply ravined, northern slopes. Broad east - west depressions and basins separating the two ridges are connected by narrow and nearly vertical-walled north - south valleys which divide the ridges into several sections. These valleys provide a grid of channelized routes. A route connecting Sevastopol' on the west coast, Simferopol' in the interior, and Feodosiya on the east coast is provided by the interridge depressions and basins. The railroad connecting the naval base-fortress of Sevastopol' with the Ukraine and Moscow runs along the interridge depression and the Salgir river valley.

Numerous small streams flow outward from the Main Range, the source of most of the water for the streams, and the main drainage divide. Whereas short, narrow, and shallow streams drain the steep south slope of the Main Range, larger and longer streams drain the less steep north slope. Conditions of flow vary considerably. For example, the rivers reach flood stage during both the spring thaw period, when the snow is melting on the mountains, and during the summer, following heavy showers on the mountains. In summer, the rivers normally contain little water; are narrow, shallow, or may even dry up. Those in the drier, eastern section are all intermittent. Even the Salgir, the largest river in the Crimea, becomes intermittent just to the north of the boundary of the region in subregion E-3. The water supply obtainable from the rivers, especially in the drier east and north, is limited and variable. The rivers may be major obstacles to cross-country movement only during the periods of high water; during the remainder of the year they can be forded at many places, although steep banks are characteristic.

Forests partly cover most of the slopes of the Main Range, and, together with the steep rocky slopes, restrict movement to a considerable degree. The forests, however, afford some concealment and timber. The lower and drier slopes have broadleaf forests, mainly oak, with Mediterranean maritime mixed forests on the western part of the south coast only. The higher and moister slopes have

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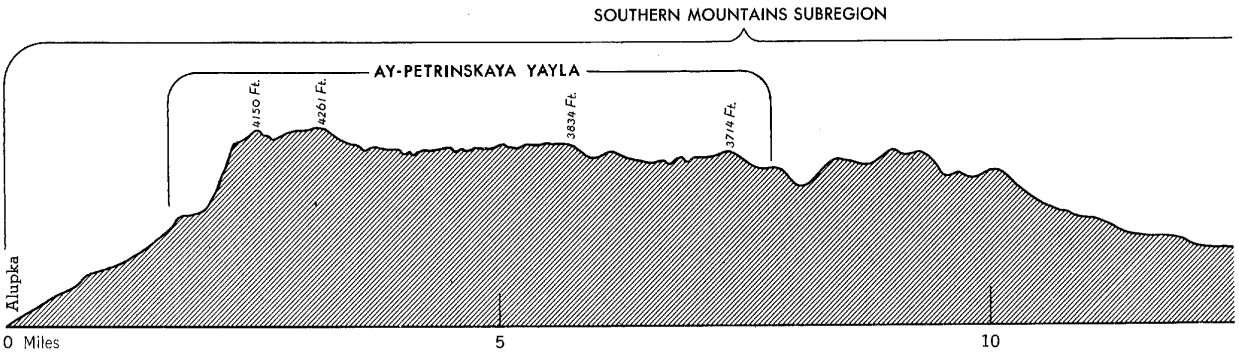

FIGURE II-134. *Profile of*
A profile from Alupka to the Bel'bek river, through

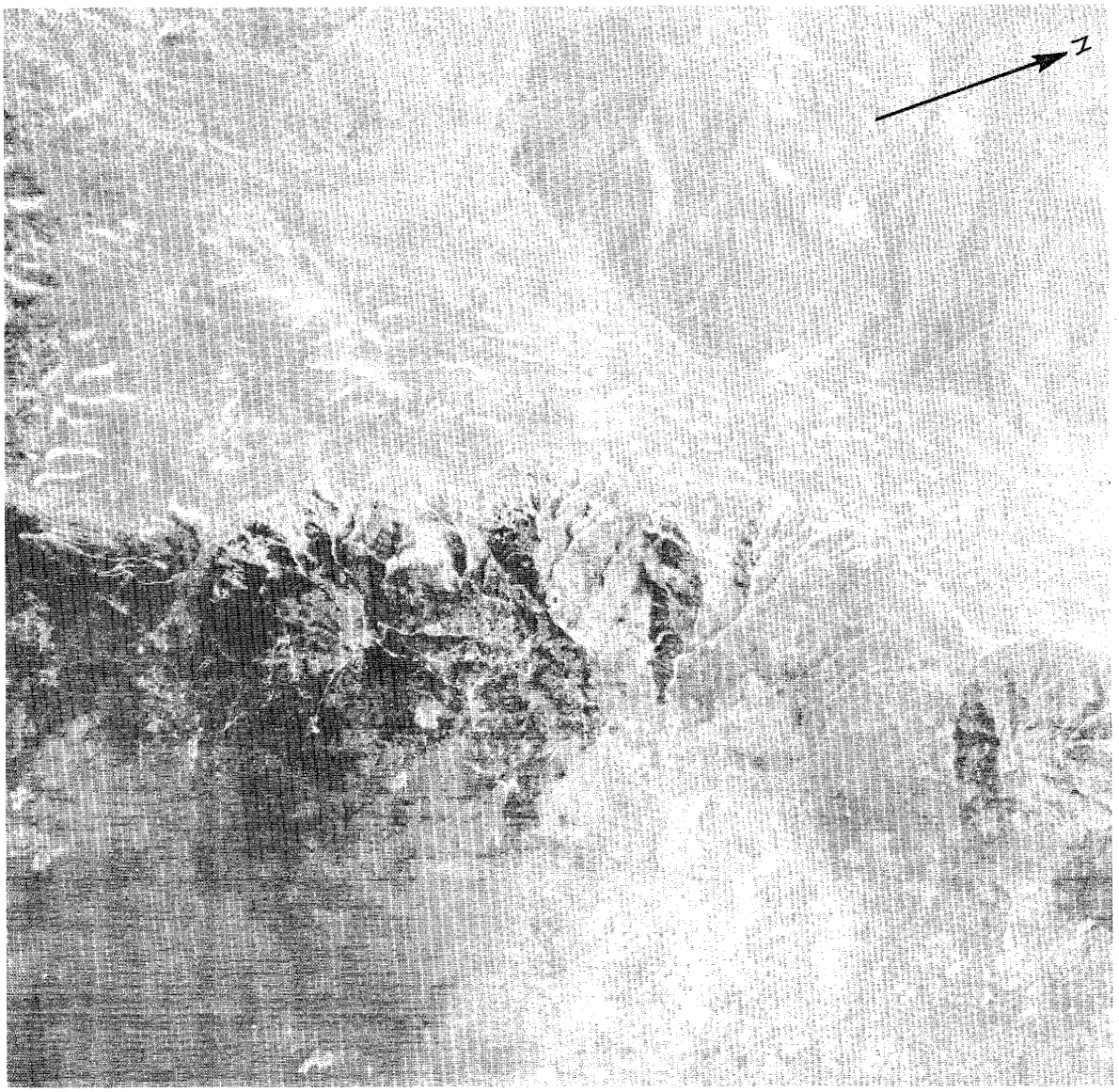

FIGURE II-135. *Yayla plateaus of the Main Range west of Yalta.*
A section of the broad plateau summit is shown across the center of the picture (light strip). White strips are probably snow patches along the irregular platform ledges and in the sinkholes and valleys. The steepness of the southern cliffs with their many waterfalls is emphasized by the zigzag roads. On the broad, lower terraces of the amphitheater (lower right) are cultivated areas, but for the most part forests, including those of the Crimean pine, cover the southern slopes. The relatively gentle, northern slopes are covered with broadleaf forests, mainly beech, with some pine. Approximate scale, 1:56.000. 1944.

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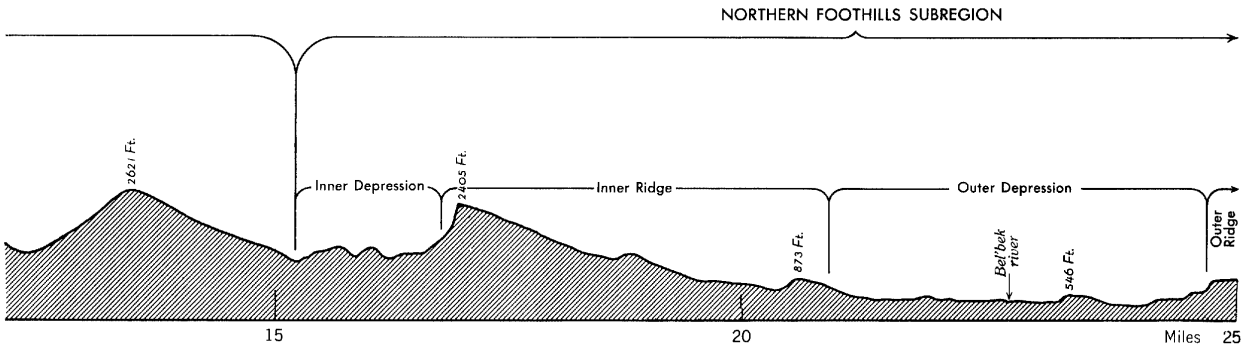

Mountainous Crimea.
the western section of the mountains and foothills.

broadleaf forest, mainly beech, and Crimean mountain pine in the western section of the southern slope only.

Widely spaced, low, drought-resistant shrubs are spread over the lower and drier slopes in the east, north, and west. Grass vegetation covers the lower part of the north slope of the Outer Ridge, and meadow vegetation the greater part of the surface of the Main Range plateaus. The shrubs, grasses, and herbaceous plants do not offer any important obstacles to cross-country movement and afford little concealment.

The most densely populated sections and the cultivated areas containing fruit orchards, vineyards, and truck farms are in the interridge depressions, basins, and valleys. Tobacco plantations are on the lower rocky slopes, or higher and drier valley terraces. On the south coast, a veritable "Soviet Riviera", there are many small cities and health resorts.

Well-drained, shallow, deep, loamy and clayey soils are found on the slopes of the Main Range and the Ridges. The soils are shallow and poor on the steeper slopes. Rock fragments are common in and on the soil; bedrock outcrops locally. Thick marls, however, are found in the valleys and in the interridge depression west of Simferopol'.

From December to February the soils are probably frozen firmly on the upper slopes of the Main Range and the Ridges. Only in very cold winters does the soil freeze firmly at sea level on the south coast. For long periods during the summer and autumn, the soils are dry and dusty. These frozen or dry surfaces favor cross-country movement of vehicles.

Soils can be expected to be muddy and slippery for about three to four weeks during the spring thawing in March and April and for short periods following local showers. During these periods most tracked vehicles could move cross-country only with difficulty and wheeled vehicles could move only on improved roads.

Differences in elevation, surface configuration, and vegetation in Mountainous Crimea may be divided into two subregions, the Southern Mountains and the Northern Foothills. The Southern Mountains subregion, the highest mountain zone, extends along the south coast of the Crimean Peninsula and is composed of a chain of plateaus, several ranges, and ridges. North of this, and paralleling its entire border lengthwise, is a foothill zone containing two major ridges skirting a number of depressions and basins. These comprise the Northern Foothills subregion. Each of these subregions will be discussed separately.

(2) Subregion F-1, Southern Mountains

(a) Relief (PLANS 2 and 3 and FIGURES II-134, II-152, and II-153).—The Main Range, the backbone of the Southern Mountains subregion, extends along the south coast for a distance of 90 miles. Although it is relatively low, the highest peaks being little more than 5,000 feet above sea level, its surface is very rough, and it presents a major obstacle to movement, especially from the south coast. The range is, in general, a chain of plateaus in the western and central sections and groups of separate ranges in the eastern section.

The plateaus are called *yayla,* meaning summer pasture, in Tatar, and thus they are referred to as the "*yayla* plateaus". In the western section, southwest of Alushta, the *yayla* plateaus form a continuous chain, but in the central section, between Alushta and Uskut farther northeast, the *yayla* plateaus are divided into large detached, mesalike masses such as the Chatyr-Dag and the Karabi-Yayla. These masses slope steeply in all directions and are separated by relatively broad, deep depressions from 1,500 to 3,000 feet below the bordering heights. The general elevation of the summits of the *yayla* plateaus is about 3,000 to 4,000 feet. Several of them rise to over 5,000 feet above sea level. The summits average about two to six miles broad, but in places are less than one mile wide (FIGURE II-135).

The open and stony summit surfaces of the *yayla* plateaus comprising the western and central sections of the Main Ridge present a marked contrast with the steep slopes of the mountains in the same area (FIGURES II-135 and II-136). In many places there are wide, level surfaces bordered by numerous low, irregular hills and rocks. In other places the plateaus are divided into platforms of various sizes and shapes which rise in steep, irregular ledges one above another. The tops of the plateaus are limestones in which there are many steep-sided valleys and hollows (sinkholes of various sizes and shapes) and underground caves, especially in the Chatyr-Dag and the Karabi-Yayla. The ledges, hills, rocks, valleys, and hollows produce an uneven summit surface in many places.

FIGURE II-136. *A part of the summit of the Babugan-Yayla.* Direction of view unreported. The summit of the *yayla* plateau is broken here by numerous irregular rocky elevations rising above the level valley. White limestone outcrops, such as appear in the foreground, are numerous in the meadows. Before 1932.

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West of Alushta, the continuous wall of the *yayla* plateaus has few passes and is a considerable barrier. The lower, western spurs of the Main Range can be crossed in a few places, notably in the vicinity of Foros on the main road through a pass (the Baydarskiye Vorota (Baydary Gates)), less than 2,000 feet above sea level. Between Foros and Alushta, a distance of over 30 miles, there are probably no passes lower than 3,000 feet above sea level. Nevertheless, roads and trails cross the surface of the plateaus, avoiding the irregular areas as much as possible, and wind down the steep southern slope to the south coast over steep grades with many hairpin curves (FIGURE II-135).

In the central section of the Main Range between Alushta and Uskut, four major "low" and open passes are found between the major mesalike plateau masses. The pass be-

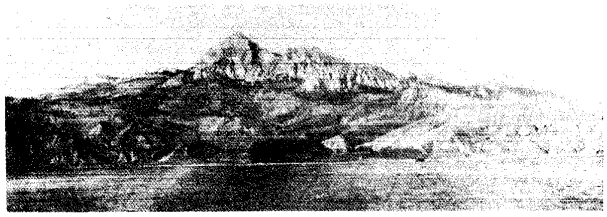

FIGURE II-137. *Kara-Dag range, southwest of Feodosiya.* Looking west. The Main Range terminates on the east in the volcanic, rocky Kara-Dag range (1,883 feet). Its jagged summit rises high above the general level of the range which, on its seaward side, drops precipitously and forms a very irregular, rocky coast. In the background appear the rocky summits of a typical limestone range, the Syuryu-Kaya. Before 1932.

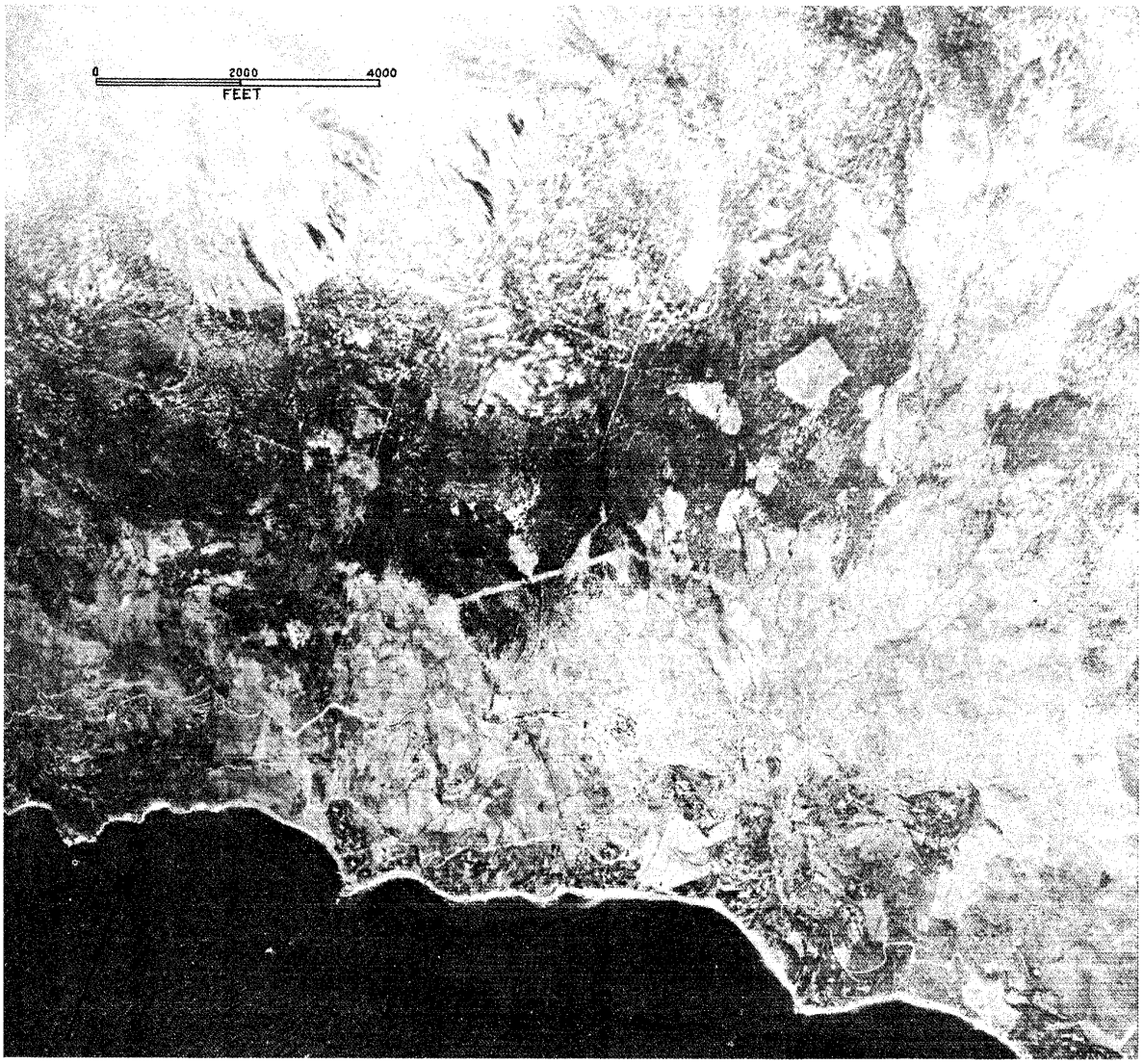

FIGURE II-138. *The southern slope of the Ay-Petrinskaya Yayla (plateau) east of Alupka.* The top of the Ay-Petrinskaya Yayla (upper left corner) has a relatively broad, level limestone surface. The upper part of the southern slope has very high cliffs (grayish areas), dropping to a zone of limestone platforms which descend to the sea in a series of steps, with alternating steep and cultivated, gently sloping sections. The middle slopes are covered with Crimean pine forest (the dark areas). March 1943.

tween the Babugan-Yayla and the Chatyr-Dag has an elevation of 1,968 feet; that between the Chatyr-Dag and the Demerdzhi-Yayla, 2,500 feet; that between the Demerdzhi-Yayla and the Karabi-Yayla, about 2,600 feet; and that between the Karabi-Yayla and several low ranges to the east, 2,500 feet. The pass between the Chatyr-Dag and the Demerdzhi-Yayla is followed by the main road connecting Alushta and Simferopol'.

East of Uskut the *yayla* plateaus disappear, and the Main Range consists of a multitude of detached, branching ranges with steep slopes. Most peaks rise from 2,000 to 3,000 feet above sea level; the highest peak is about 3,130 feet. In the extreme east, the Main Range terminates in the Kara-Dag and Syuryu-Kaya ranges (FIGURE II-137). In this eastern section the Main Range can be crossed through several low passes less than 2,000 feet above sea level. The main road connecting Saly and Sudak follows a pass about 1,300 feet above sea level between the Sugut-Oba and Syuryu-Kaya.

The southern side of the Main Range and the south coast have a diversified relief. In the section west of Alushta the continuous chain of *yayla* plateaus is bordered on the south coast by very steep cliffs, which attain an elevation of several hundred feet (FIGURES II-138 and II-139). At the foot of the cliffs, generally less than three miles from the south coast, is a zone of platforms and low mountains. These slope down to the sea in great steplike sweeps, in places forming rocky headlands. At Mys Ayya, at the extreme western end of the Main Range, the mountains reach the sea in almost vertical cliffs more than 1,600 feet high. Low, block ranges, typically 600 to 1,000 feet above sea level, and steep, rocky hills separated by angular basins extend to the coast west of Balaklava (FIGURE II-140). Between

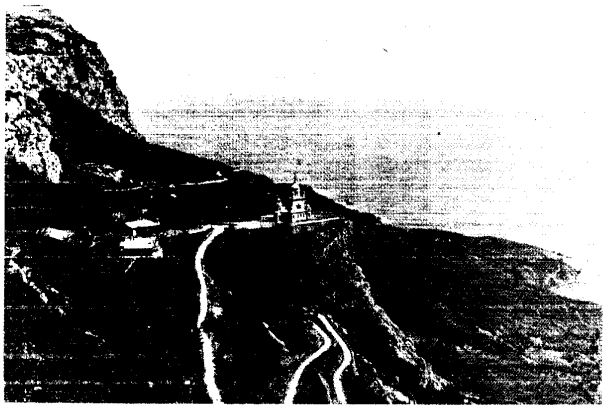

FIGURE II-139. *The steep southern coast of Crimea near Foros.* Looking southeast. Between the *yayla* plateaus and the sea in this section is a very narrow coastal lowland. Behind it the face of the range rises in very steep slopes and high, almost perpendicular walls. The road ascends the slopes in hairpin turns and crosses the main range through a pass, known as the Baydarskiy Vorota (Baydary Gate), to the city of Baydary. Scrub vegetation covers the slopes. Before 1941.

(Mys) Ayya and Alushta, narrow strips of shore drop to the sea in continuous, steep slopes furrowed with ravines and gullies. In some places the rocky mountains and spurs with precipitous slopes projecting to the coast enclose "amphitheaters" of various sizes such as at Yalta and Gurzuf which open toward the south. Within these amphitheaters are broad, stream terraces with gentle-to-moderate

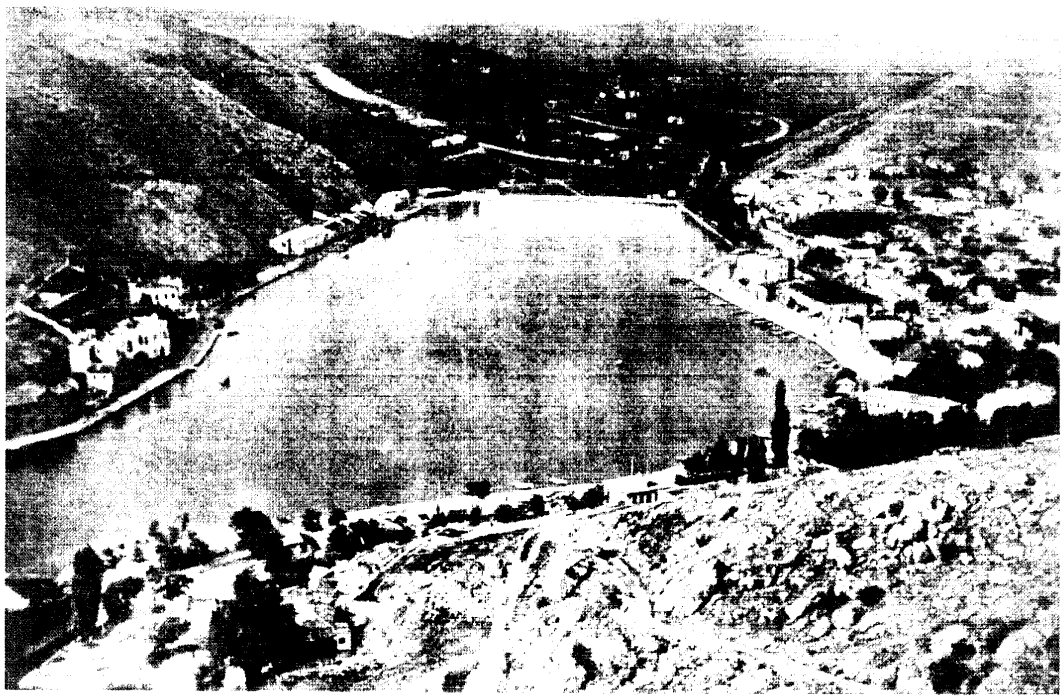

FIGURE II-140. *Steep, rocky slopes of the Main Range at Balaklava.* Probably looking north. Balaklava is a health resort on the southwest coast. The narrow bay, enclosed by steep, rocky hills, serves as a naval base. Before 1941.

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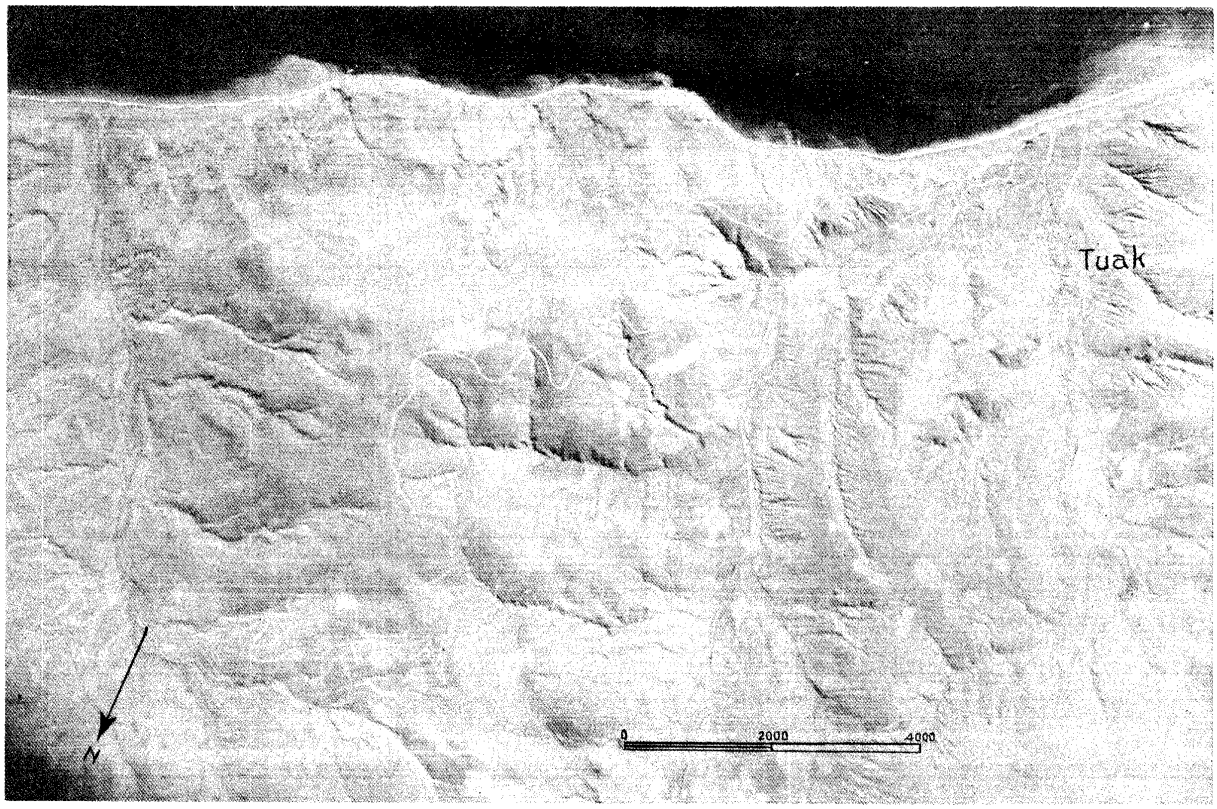

FIGURE II-141. *The Tuak coastal district, on the south slope of the Karabi-Yayla (plateau).*
The lower slope of the Karabi-Yayla is cut by a large number of rather broad and terraced valleys open to the sea and by numerous gullies. Small, comparatively level areas, part of which are cultivated, are located between the valleys. The main coastal road winds across the area, avoiding the steep slopes and larger valleys and gullies. March 1943.

slopes (FIGURE II-135). These terraces are dissected by an intricate network of valleys, ravines, and gullies.

From Alushta eastward to the vicinity of Kapsikhor and the river Voron, the *yayla* plateaus and ranges to the east are three to six miles inland from the coast. From the base of the high cliffs bordering the plateaus and the base of the steep slopes of the ranges to the east, the surface slopes somewhat gradually to the sea in broad steps. There are comparatively flat areas between streams which have cut ravines and gullies (FIGURE II-141). In the Kapsikhor district the slope is less steep. It is cut by broad, north-south trending valleys of relatively large streams.

East of Kapsikhor and the river Voron, the relief of the southern slope of the Main Range and the south coast is again extremely diversified. A series of low mountains extends down to the coast and between them are basins and lowlands such as those at Kutlak, Sudak, Meganom, and Otuzy. These basins are crossed by river valleys with gently-to-steeply dissected, terraced valley sides (FIGURE II-142). Some of the ranges and mountains, such as Gora Ardych-Kaya (1,168 feet above sea level), are separated from the main ranges by terraced basins. The slopes of some of these ranges are unusually steep and precipitous, particularly on the seaward side, where cliffs of great height rise sheer from the sea. The slopes of the coastal ranges of the Kara-Dag drop steeply from a height of 1,440 feet to the sea (FIGURE II-137).

The northern side of the Main Range is less steep than the southern side (FIGURES II-134 and II-135) and is broadest in the western part, where it is 12 miles wide in places. Along most of its length it extends down to the valleylike depressions and basins of the Northern Foothills subregion, which has an elevation of about 1,300 feet in the western and central parts, and about 900 feet in the eastern part.

The relief varies greatly from place to place. At several places steep-sided block mountains are separated from the *yayla* plateaus by deep, steep-walled canyons. At higher elevations, the surface is much cut up by a ramified system of narrow and steep-sided valleys which contract to narrow gorges in many places. At lower elevations, especially

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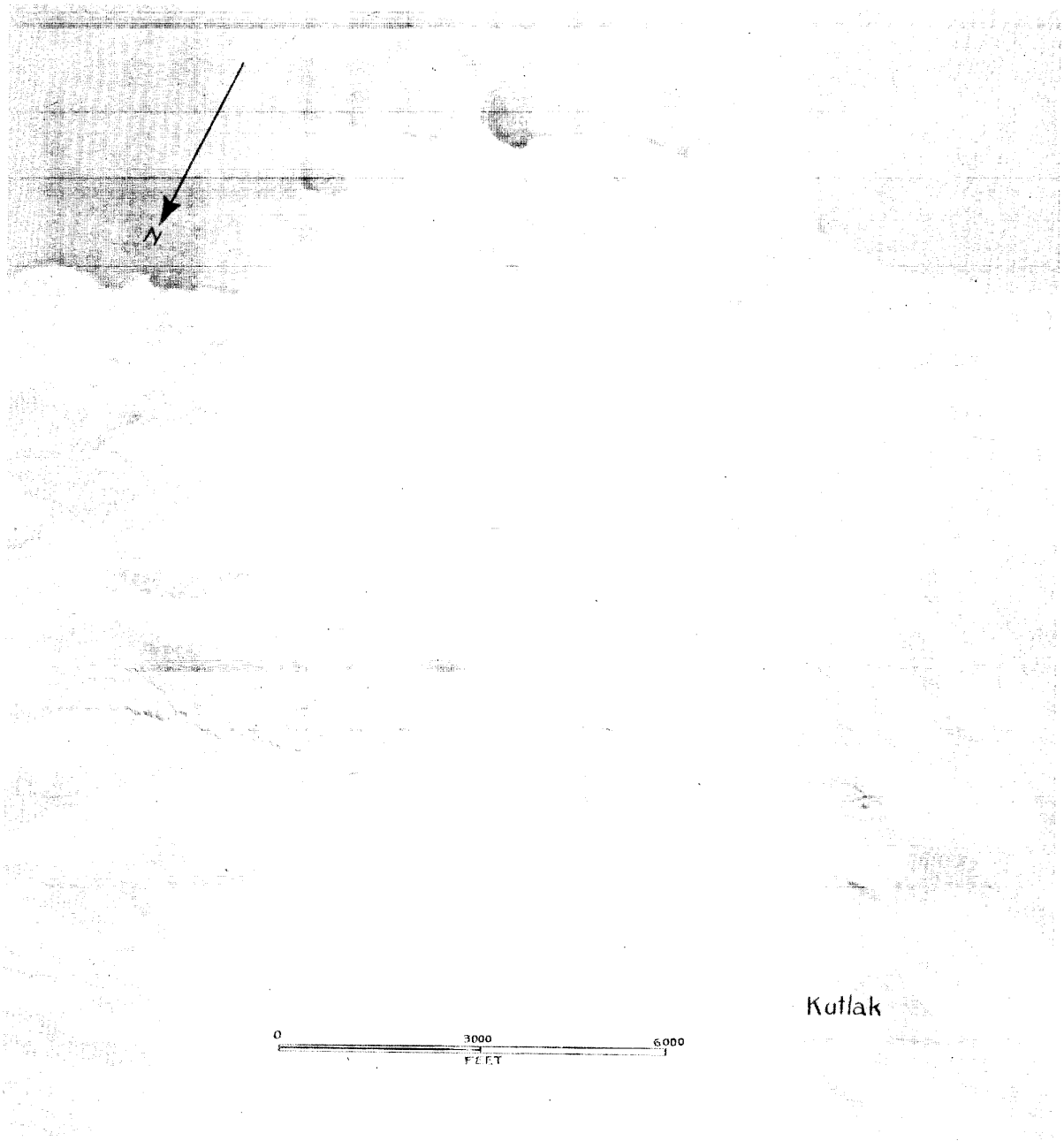

FIGURE II-142. *Coastal area in the vicinity of Kutlak.*
This coast line is very indented and presents a succession of steep-sloped spurs projecting from the adjacent ranges; in places the spurs rise almost perpendicularly from the water. Between the ranges are broad basins and valleys fronting the sea. Typical of these basins is the Kutlak basin (lower right), in which several tiers of high terraces rise from the banks of the river which crosses it to the sea. The terraces are covered mainly with vineyards and orchards. The main coastal road (lower right) passes through the city of Kutlak. March 1943.

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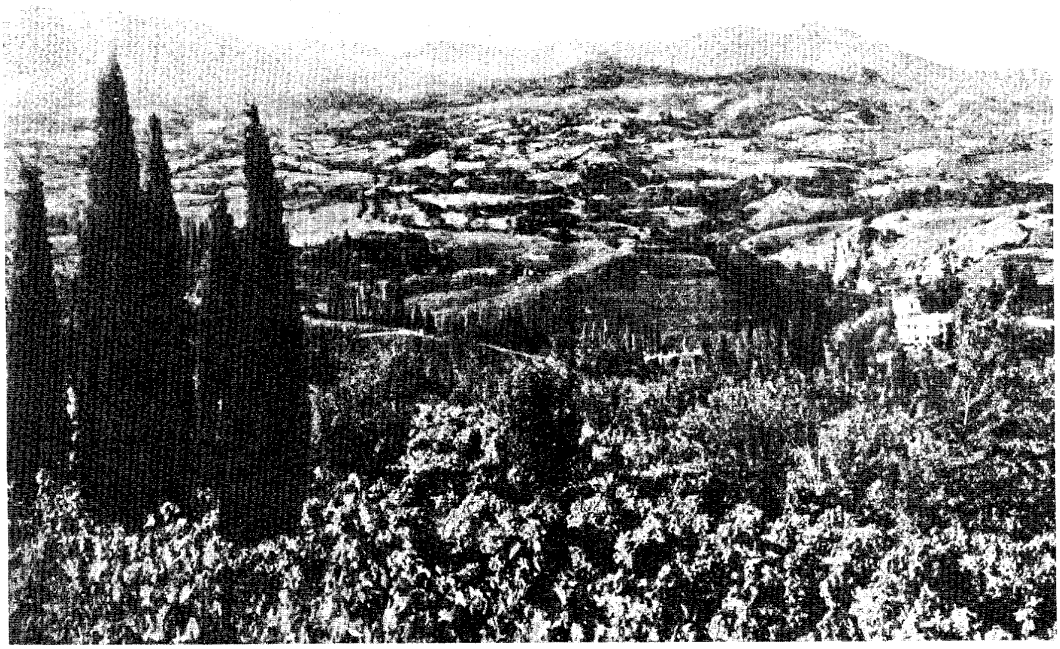

FIGURE II-143. *The northern slope of the western half of the Main Range.*
Probably looking southeast. The lower part of the broad, northern slope of the western half of the Main Range has many rolling hills whose surface is covered by numerous vineyards, orchards, and forests, mainly oak, with shrub growth. The *yayla* plateaus of the Main Range appear in the background. Before 1941.

in the western half, the surface is hilly, with branching river valleys where slopes are comparatively gentle (FIGURE II-143). The Baydary basin on the river Chernaya, at an elevation of about 1,000 feet, and the basin of the upper Salgir river, with elevations between 1,000 to 1,900 feet, have relatively broad, level surfaces, but they are broken by low hills.

Valleys of the larger rivers and streams throughout the subregion are broad in the middle and lower courses and contain valley flats and terraces which increase in height toward the Main Range. These river terraces are much cut up by streams. The valleys lie at right angles to the Main Range and provide the only practicable transverse routes over it (FIGURE II-135).

The mountainous terrain directly affects and limits movement, especially on the southern slopes, to a few basins and valleys and level sections on the summit of the *yayla* plateaus. In the basins and valleys, deeply dissected terraces and steep valley slopes restrict movement (FIGURES II-141 and II-142). On the level section of the *yayla* plateaus tracked vehicles can move cross-country, but in other sections movement would be handicapped by steep-walled ledges, hills, valleys, sinkholes, and outcropping rocks (FIGURES II-135 and II-136). Routes used must be carefully selected. Here bridging may be necessary to cross gaps left by broken or dynamited roofs of underground caverns.

On the whole, rapid movement of vehicles is extremely difficult or impossible off the roads. The mountain ranges can be crossed only along roads which for the most part follow relatively low passes, the approaches to which are over steep grades and many hairpin curves. The network of main roads could be kept open for traffic, if properly maintained, even in the winter, when ordinarily they may be blocked by relatively heavy snowfall (November to April) in the mountains.

(b) Drainage (PLAN 4 and FIGURE II-152).—The crest of the Main Range forms the primary drainage divide and directs the flow of the numerous streams which originate on it. Much of the precipitation which falls on the Main Range is absorbed and penetrates deep into the limestone plateaus and mountains. Thus, there are few surface streams on the summit of the *yayla* plateaus (FIGURES II-135 and II-136). The snow which accumulates on the higher slopes during the winter usually begins to thaw some time in April or May. Its gradual melting in the spring plays an important part in feeding the rivers and ground waters. At places where the limestone strata are underlaid by impermeable rock, the water reaches the surface in the form of strong-flowing springs. Some of these springs are the outbreak of subterranean rivers and are the sources of the Bel'bek, Salgir, Biyuk-Karasu, and other rivers. Almost all the larger Crimean rivers are fed by these underground waters. Particularly heavy rains on steep sections of the mountains and occasional rapid thawing of snow sometimes result in landslides. These are prevented in part by capturing the surface and underground waters and guiding them away from the threatened sections.

Streams draining the southern slope of the Main Range are short, most of them being no more than five to eight miles long. Their beds are steep and filled with great boulders. The streams are relatively narrow and shallow, with steep banks. The upper courses pass through narrow gorges, marked with many waterfalls. All of the streams on the south side of the Main Range east of Gora Sugut-Oba are intermittent, and many of the smaller ones are dry most of the year. The south coast suffers from protracted summer droughts; during that time even the larger streams have little water.

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The major rivers of the Crimea rise on the northern side of the Main Range. They are much longer than those on the southern side but they, too, are shallow and narrow. Steep banks are common, especially along the headwaters. Except at flood stage the streams carry little water.

The season of high water comes with the spring rains and the melting of snow on the mountains. Occasional heavy summer rains, the form in which most of the summer precipitation falls, also raise the level of the streams to flood state. The run-off, however, is rapid and the torrents, especially on the south side, swiftly pass to the sea, conditions of flow changing from hour to hour. The building of reservoirs and other measures for the regulation of water run-off is reported to be important in the economy of the south coast.

Probably only during unusually cold winters do the water bodies of this subregion freeze over completely at low elevations. Only in exceptionally cold winters does ice form on the south coast. Water bodies on the intermediate slopes probably have ice for a period of about 30 to 90 days between the end of December and the middle of March. On the top of the *yayla* plateaus ice probably lasts considerably longer.

Water supply is limited, especially on the drier south coast. The rivers are major obstacles to movement only during high-water stages in spring and occasionally in summer. During the rest of the year, it is reported, the streams can be forded at various places. Their steep banks, however, are obstacles to wheeled vehicles.

(c) Vegetation (PLAN 5 and FIGURE II-154).—The vegetation of Mountainous Crimea can be divided into four general types: grass, shrub, forest, and crop. Of these the forests occupy the greatest area, covering about three-fourths of the total surface. The greater part of the summit surface of the *yayla* plateaus is covered by grassy mountain meadows, most of whose plants are but a few inches high (FIGURE II-136). These meadows furnish summer pasture for flocks of sheep and goats.

Widely spaced stands of drought-resistant, deciduous shrubs are on the intermediate and lower southern slopes of the central and eastern, drier sections of the Main Range (FIGURE II-142). This scrubby growth includes dense, thorny stands of the "catch tree," shrubby forms of oak, small-leafed hornbeam, and the pear tree, with intermingled species of treelike juniper, sage, and others. Tough, downy or thorny, extremely drought-resistant subshrubs (very low-growing shrubby plants) form open and scattered stands, between which grow many drought-resistant herbaceous plants and grasses of the steppe type of vegetation. Such areas are found on the lowest and driest, north slopes of the Main Range and on the lower slopes of the mountains and the coast in the extreme eastern part of the subregion. Rocky peaks of the *yayla* plateaus have a combination of drought-resistant vegetation containing small bushes, shrubs, subshrubs, and some squat alpine plants. The widely spaced, low shrub growths do not offer any obstacles to the movement of wheeled or tracked vehicles, and provide no natural means of concealment.

Forest vegetation is confined largely to the slopes of the Main Range. Large sections of the lower coastal slopes, basins, and valley floors have been cleared. The forests show both a pronounced vertical zonation on the mountain slopes and marked differences between the northern and southern slopes. In general the higher and more moist north and south slopes are occupied by broadleaf forests, mainly beech (FIGURE II-135). Such forests are above an elevation of about 2,000 or 2,300 feet on the northern slope and above 2,300 to 2,600 feet on the southern slope. They extend up to the edge of the summits of the *yayla* plateaus at 4,300 feet. Below about 3,600 feet elevation, high-trunked beech trees occupy slopes with a northern exposure, and European chestnut oaks are mingled with the beech forest on slopes with a southern exposure.

Above 3,600 feet at some places the beech often assumes a bushy, low-trunked form. There are several places where other species interrupt the over-all pattern above. Crimean mountain pines form a short, narrow belt on the western section of the southern slope of the Main Range from 1,000 feet above sea level to the edge of the *yayla* plateaus (FIGURES II-135 and II-138). These pines also appear in the upper part of the northern slope, being at some places intermingled with low-trunked beech forests and at others forming independent growths. In depressed sections and at the bottom of many sinkholes on the *yayla* plateaus, bushes and trees, mainly of beech and pine, grow.

On the lower and drier north slope between an elevation of 300 to 800 feet and 2,000 feet above sea level continuing around, and on the south slope between an elevation of 1,000 feet and 2,300 to 2,600 feet, is another wide zone of broadleaf forests, mainly oak (FIGURE II-139). The trees in general, especially those growing in the driest sections below 800 feet elevation, branch very close to the ground and thus are short-trunked. There is an undergrowth of hornbeam, cornel, and various shrubs throughout the oak forest area. Extensive areas of alder-hazel stands are found in the river valleys.

The Mediterranean maritime mixed forests grow on the south coast from sea level up to about 1,000 feet elevation, or somewhat higher in places (FIGURE II-139). It consists largely of short-trunked oaks and junipers with wild pistachio, some species of ash and elm, and an undergrowth of a wide variety of herbaceous and shrubby plants. Many of the plants in this vegetation type are green all year. To the east of Alushta the evergreen undergrowth disappears and the forests become poor, mostly because of the greater dryness there. Gradually the forest of the west is displaced by drought-resistant, deciduous shrubs. On the driest and stoniest slopes where the forests have been cut, are low-growing, extremely drought-resistant subshrubs forming open and scattered stands, between which grow small drought-resistant plants.

The forests on the mountain slopes offer better opportunity for concealment than the grasses or shrub growth. The mountain forests provide the only relatively large source of timber for miles and are a local supply of material for construction purposes and fuel. The forests, in addition to the steep, rocky terrain of the mountains, restrict maneuverability to roads and small strips of land.

Along the south coast are numerous cities with villas located in the midst of well-kept gardens and parks, alternating with cultivated fields, many enclosed by stone walls, typically about two feet high and one foot wide. In many places the dark green, forested slopes of the ridges overlook extensive fruit orchards and vineyards in the valleys. Tobacco plantations are laid out at many places on the rocky slopes and on higher and drier valley terraces. A typical valley landscape such as found at Alupka, Yalta, Gurzuf, Alushta, or Sudak includes a resort center on the broad, lower river valley surface spread out amid orchards, vineyards, and parks, with tall stately cypresses, pines, cedars, magnolias, laurels, and other ornamental southern plants (FIGURE II-144).

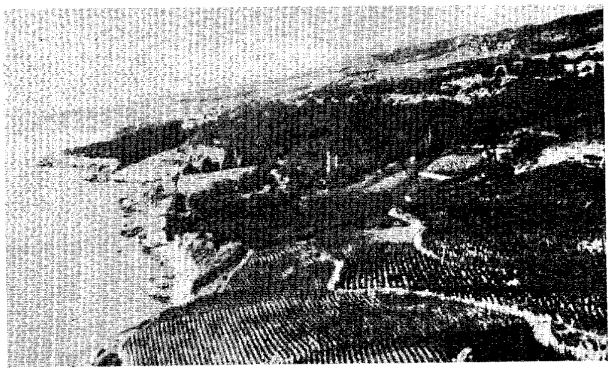

FIGURE II-144. *South coast of Crimea, east of Alupka.* Looking west. This typical landscape of the south coast includes sites of sanatoriums, rest homes, and parks with cypresses and ornamental plants, surrounded by orchards, vineyards, and tobacco plantations. The coastal zone is composed of alternating steep and gently sloping areas. Before 1932.

In the area north of the crest of the Main Range cultivated sections such as truck farms, fruit orchards, vineyards, and tobacco plantations are confined to strips along the streams, and to the lower hills of the northern slope of the Main Range (FIGURE II-143).

The cultivated crops and plants in the valleys and on slopes do not offer any serious obstacles to the movement of wheeled or tracked vehicles, and they provide some opportunity for concealment.

(d) Trafficability of surface materials (PLANS 6 to 9).—Relatively soft rocks are found in the valleys, basins, and on the lower slopes of the Main Range. Relatively hard rocks constitute the bedrock of the plateaus, mountains, and ridges of the Main Range. These rocks outcrop locally and rock fragments are common (FIGURES II-136, II-139, and II-140). Road construction is not rapid across the latter areas.

Because of the great diversity of relief, climate, vegetation, and surface materials, the soils differ considerably from place to place. They have a wide range of drainage conditions, texture, and thickness over bedrock. Since the soils are discussed in terms of the generally dominant conditions, local variations from these conditions should be expected.

The slopes of the mountains and plateaus have well-drained, shallow and deep, loamy, and clayey soils. Especially on slopes west of the river Al'ma and on the steeper slopes throughout the area the soils are thin and poorly developed. Deeper soils are found in the valleys and basins, such as the Baydary basin.

Landslides are encountered on the steeper slopes and sometimes cause great damage to highways and buildings. The fallen materials on the southern slopes of the Main Range form "chaoses" (piles of boulders) at places along the coast and at the foot of the precipitous walls of the *yayla* plateaus and mountain masses. These are local developments and usually can be avoided. More widespread are great heaps of finer, weathered fragments forming whole mantles of deposits on the slopes of the Main Range (FIGURE II-153).

Soils are probably frozen firm on the upper slopes of the mountain masses during December, through February, and probably for a month or more longer on the *yayla* plateaus (PLAN 9). Heavy frost occurs only in these areas, and wheeled and tracked vehicles can move rapidly on the frozen soils. Based on very limited information it appears that at Yalta and other places on the southern coast of the subregion no firmly frozen ground is to be expected. Here frosts occur infrequently. For example, the frostless period is about 250 days on the south slopes compared to about 150 days on the *yayla* plateaus.

Soils can be expected to be slippery and muddy for about three weeks or a month during the spring thaws which occur in late April on the *yayla* plateaus and higher mountains (PLAN 6); these thaws come between early March and late April on the slopes of the main range. In these areas during this period most tracked vehicles could move only with difficulty, especially in gullies, and wheeled vehicles would be stopped except on the roads.

Soils are slippery and muddy locally for short periods following the infrequent showers which occur throughout the year on the south coast and mainly in the summer in the rest of the subregion. Rapid drainage of the porous limestone surface counteracts the effects of the heavier and more frequent showers which occur on the *yayla* plateaus. Thus, the surface is kept dry.

During a large part of the summer and autumn the soils of the entire subregion are dry and dusty because a considerable portion of the rainfall during these seasons falls in the form of short, heavy showers, followed by long periods of warm, sunny weather (PLANS 7 and 8). Movement of both tracked and wheeled vehicles is favored by the dry surface conditions.

Building materials are abundant. In some places in the Main Range, marble and hard, crystalline limestone are quarried. At Balaklava limestone is quarried for use as high-grade flux in the metallurgical plants of Kerch' and the Ukraine.

(3) Subregion F-2, Northern Foothills

(a) Relief (PLANS 2 and 3, and FIGURES II-152 and II-153).—Below the northern slope of the Main Range is an arc-shaped belt of foothills formed by two ridges with steep southern and gentle northern slopes (FIGURE II-134). These ridges are called the Inner Ridge (on the south) and the Outer Ridge (on the north). The ridges are separated

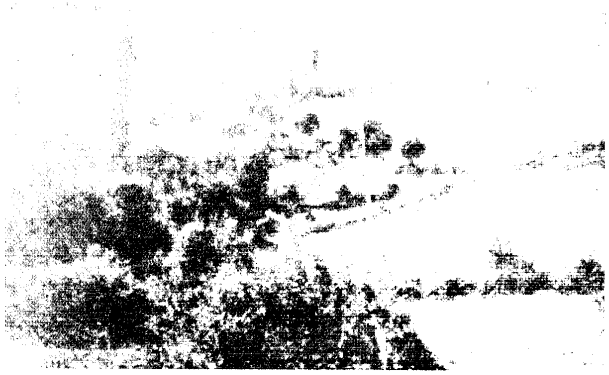

FIGURE II-145. *The Bel'bek river valley, about 10 miles southeast of Duvankoy.*
Probably looking southeast. The Bel'bek river flows from the north slope of the Ay-Petrinskaya Yayla through the Inner and Outer Ridges and empties into the sea north of Sevastopol'. Pictured above is the entrance to the deep gorge cut by the Bel'bek river through the Inner Ridge and, in the middle and foreground, a section of the Outer Interridge Depression where it is crossed by the Bel'bek river valley. The main road, connecting Yalta on the south coast with Duvankoy on the Sevastopol'-Simferopol' railroad, follows this gorge. Before 1941.

FIGURE II-146. *The steep-walled valley of the Churuk-Su river at Bakhchisaray.*
Direction of view unknown. The Churuk-Su river is a tributary of the Kaga river which cuts through the Inner Ridge and provides a corridor connecting the Inner and Outer Interridge depressions. The short grass is interspersed with light-colored limestone outcrops. Note in the background the even skyline of the Inner Ridge. Before 1941.

from each other and from the Main Range by a series of depressions and basins. Transverse valleys divide the ridges into a number of separate heights.

The Inner Ridge is higher and narrower than the Outer Ridge. The section west of Simferopol' averages 1,340 to 1,500 feet above sea level, and has a maximum elevation of about 2,400 feet. The section in the vicinity of Belogorsk (formerly Karasubazar) is a little higher, averaging 1,500 to 2,000 feet with a maximum elevation of about 2,500 feet. The Inner Ridge averages two to six miles in width. There are rocky cliffs along the southern edge of the Inner Ridge and at places where it is cut through by narrow, north-south gorges of the major streams (FIGURES II-145 and II-146). Near the southern edge are some scattered hills, with steep, rocky slopes, made up of giant limestone steps and ledges. Many caves extend into these limestone ledges. The steep slopes and caves provide a unique kind of natural fortress and were used in antiquity as populated and fortified centers.

The northern slope of the Inner Ridge is relatively flat and descends gently at an angle of about 10 degrees to the outer depressions and basins (FIGURE II-146). The surface of this northern slope is cut by many narrow, steep-walled ravines (FIGURES II-147 and II-148).

The Outer Ridge is considerably lower and broader than the Inner Ridge, averaging in its central part about 300 to

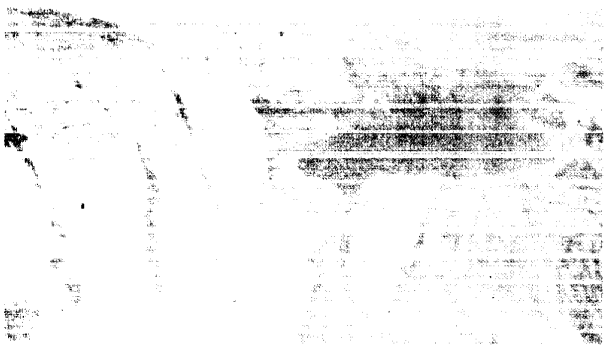

FIGURE 147. *A ravine in the Inner Ridge north of Bakhchisaray.*
Direction of view unknown. Deep ravines cut into the Inner and Outer Ridges and channelize movement through them. The sides of the ravines are mostly bare rock walls; many are vertical. Vegetation is found only on the valley floors. Before 1941.

400 feet above sea level along its northern base, and about 1,000 to 1,200 feet along its summit. This ridge averages about 11 miles wide in the west and about six miles in the east. The northern slope of the Outer Ridge, like that of the Inner Ridge, has a generally flat surface which slopes gently (at an angle of only about 3 degrees) to the plain at the north. The southern side of the ridge, however, is

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FIGURE 148. *The Outer Interridge depression, west of Bakhchisaray.*
In the lower part of the photograph the river Kaga is shown cutting through the Outer Ridge in a deep gorge. The dark areas in the lower left and right corners are sections of the relatively flat, gently sloping, north side of the Outer Ridge. The steep, southern slopes (light areas) of the Outer Ridge overlook the level surface of the Outer Interridge Depression covered with orchards, vineyards, and tilled fields. The railroad and the asphalt-surfaced road, connecting Sevastopol' and Simferopol', pass through Bakhchisaray. The light-colored strips in the upper part of the photograph indicate the nearly vertical-walled ravines cut into the northern slope of the Inner Ridge by tributaries of the river Kaga. May 1944.

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FIGURE II-149. *Sevastopol' and vicinity.*
Movement of tracked and wheeled vehicles is restricted in the vicinity of Sevastopol' by deeply cut, narrow, steep-walled river valleys. The lower western section of the Outer Ridge is composed of round-topped, steep-sided hills which end in steep cliffs along the coast. May 1944.

steep. There are rocky cliffs along its edge and at places where the ridge has been cut by major transverse river valleys (FIGURE II-148).

In the extreme western section of the Outer Ridge in the vicinity of Sevastopol' the relief is less pronounced, but there are steep-sided, round-topped, rocky hills. Rivers have cut steep-walled valleys in the ridge (FIGURE II-149).

In the extreme eastern section, east of the Main Range in the vicinity of Feodosiya, the Outer Ridge is broken up into detached hills and basins such as at Koktebel' (FIGURE

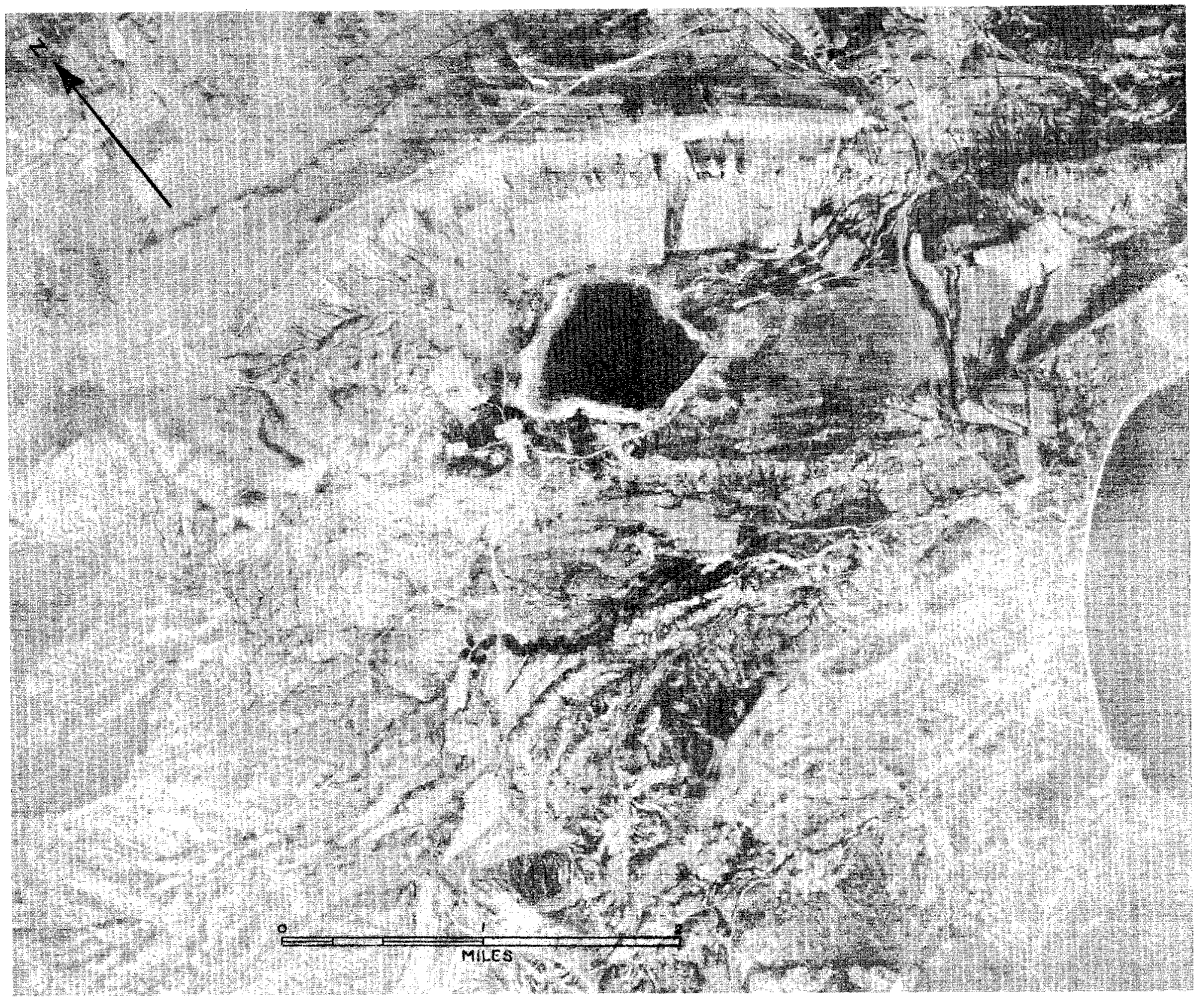

FIGURE II-150. *Aerial view of Koktebel' and vicinity.*
In the eastern part of the Northern Foothills the relief is broken up into hills and basins, and the coast is irregular. A portion of the top of the Outer Ridge appears in the upper left corner. On the gentle slopes at the foot of the cliffs below the summit are vineyards and fruit orchards. May 1944.

II-150). Feodosiya lies on the slopes of a 525-foot hill which projects into the sea forming Mys Il'i.

Sinkholes such as those found on the *yayla* plateaus of the Main Range also occur on both the Inner and Outer Ridges; the sinkholes are less numerous and smaller, however, than on the Main Range, for limestone layers are thinner and differ in composition.

The two southwest - northeast trending interridge depressions west of Simferopol' are known as the Outer Depression (between the Outer and Inner Ridges) and the Inner Depression (between the Inner Ridge and the Southern Mountains subregion) (FIGURE II-134). Each depression has an average width of about two miles and probably is no more than three miles wide at any place. The general elevation of the Outer Depression increases from about 300 to 600 feet in the west to 600 to 900 feet in the east. The Inner Depression is somewhat higher, varying from about 900 to 1,300 feet above sea level and being higher on the southern than on the northern side. The floors of the depressions, particularly of the outer one, are relatively flat, but are interrupted with hills. In the Outer Depression these hills are low and rounded (FIGURE II-151); in the Inner Depression they are higher, often steep sided, and more numerous.

East of Simferopol', for a distance of about 20 miles, the Inner and Outer Depressions unite, and the depression varies in width from five to eight miles. Its surface averages about 600 feet above sea level at the northern edge and about 1,300 feet at the southern edge. Ridge remnants and low cliffs produce a diversified, uneven surface compared to that of the Outer Depression west of Simferopol'.

In the vicinity of Belogorsk (formerly Karasubazar) is a series of basins separated by broad expanses of the broken Inner Ridge. The basins average about 600 to 900 feet above sea level, and the ridge remnants rise above them, reaching a maximum elevation of about 2,500 feet. The surface of the basins is hilly and there are steep slopes in places, especially in the southern section.

Throughout the subregion nearly all of the larger and some of the smaller rivers have more or less broad and fairly level valleys containing a series of low river terraces. The river valleys narrow to one or two miles for the larger rivers, and to one-half mile and less for the smaller rivers; at places these valleys change into narrow gorges with almost perpendicular walls as they cut through the Inner and Outer Ridges (FIGURES II-145 and II-146). The river valleys connect the interridge depressions and basins with

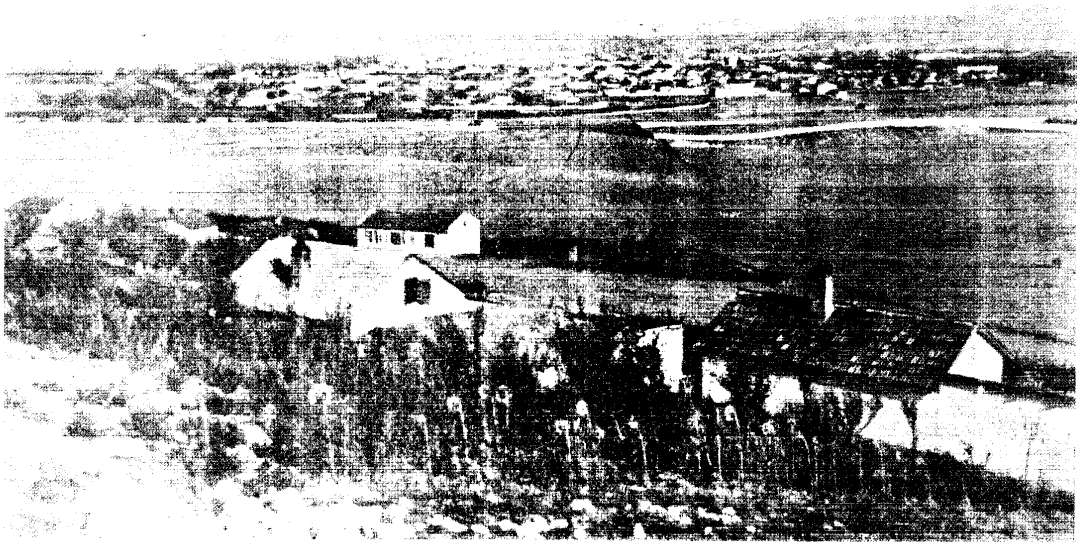

FIGURE II-151. *The Outer Interridge Depression at Simferopol'.*
Probably looking northwest from the base of the northern slope of the Inner Ridge. The steep, southern slope of the Outer Ridge shows in the background and the notch in the skyline probably marks the valley of the river Salgir where it cuts through the ridge. Cultivated fields cover the surface of the depression. Before 1941.

the lowland to the north of the region and with the passes across the mountains of the Southern Mountains subregion.

Throughout the subregion, maneuverability is channelized by the narrow and deeply cut valleys and ravines where the rivers cut into the Inner and Outer Ridges, and by the cliffs on the southern edge of the ridges overlooking the interridge depressions and basins. Here the terrain offers excellent cover and concealment. Within the interridge depressions and basins the gentle relief favors movement of vehicles. The major east - west route follows the relatively broad, level interridge depressions and basins connecting Sevastopol', Bakhchisaray, Simferopol', Belogorsk (Karasubazar), and Feodosiya. Along this route is an asphalt-surfaced road and, for part of the way, a railroad. There are several north - south routes which follow the gaps cut by the rivers through the Inner and Outer Ridges; the major one, containing the railroad connecting Sevastopol' and Moscow, follows the Salgir river valley (FIGURES II-145 to II-147, and II-151).

According to the experience of the Germans during World War II, movement of tracked and wheeled vehicles is restricted in the area around the fortress of Sevastopol' (FIGURE II-149), the important naval base on the Crimean Peninsula, by the deeply cut valleys to the northeast, and by the mountain spurs to the south. However, the local use of mechanized vehicles is possible. Steep slopes of hills in sections of the inner depression and basins along the southern border of the subregion offer some restrictions to the rapid movement of vehicles.

(b) Drainage (PLAN 4 and FIGURE II-152).—Several small rivers rising on the northern side of the Main Range drain the Northern Foothills subregion. The Inner and Outer Ridges west of Simferopol' forms a drainage divide between the rivers flowing westward into Zaliv Kalamitskiy and those flowing northward into the Sea of Azov. The rivers are relatively short, narrow, and shallow. Even the Salgir, the largest river in the whole Crimea, has an average depth of only two feet after it leaves the hills and passes into the steppes to the north, where it dries up in summer.

During the thawing of snow on the plateaus and mountains in the spring and after heavy showers in summer, the streams become torrential; their waters carry much sand and cause dangerous local floods. An area particularly subject to floods is located along the river Burul'cha, a tributary of the Salgir, near the base of the Outer Ridge.

Water bodies at low elevations freeze over completely only during the coldest winters. At higher elevations in the interior, water bodies probably have ice for a period of about 30 to 60 days in January and February, especially during the colder winters.

The rivers are temporary major obstacles only during the flood period of spring and occasionally in summer. During the rest of the year, it is reported that the rivers can be forded at many places. Locally, steep banks are obstacles to wheeled vehicles. While the Outer Ridge merges into the steppe to the north, the water supply from streams is limited.

(c) Vegetation (PLAN 5 and FIGURE II-154).—Similar to the Southern Mountains subregion, there are four general types of vegetation: grass, shrub, forest, and crops. However, forests cover only a small part of the surface. The areas covered by grass and shrubs are approximately equal.

The grassland consists of steppe with sections of sparse oak forest. Grass occupies an almost unbroken belt of varied width along the lower part of the northern slope of the Outer Ridge. Along its higher, southern margin small sections of low-trunked oak forest project from the forested slopes to the south. Grasslands provide good surface for vehicles.

Tough, downy or thorny, low-growing, extremely drought-resistant subshrubs form open and scattered stands, between which grow many drought-resistant plants and grasses of the steppe type of vegetation. This vegetation is found on the Outer Ridge and interridge basins south of Sevastopol', the upper slopes of the Inner Ridge,

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the interridge depression and basins, and part of the Inner Ridge east of the river Al'ma, and hills and basin west and south of Feodosiya. These widely spaced, low shrub growths do not materially interfere with the movement of vehicles, but do not provide natural means of concealment.

Forest vegetation, mostly oak, is found primarily on the upper slopes of the Inner and Outer Ridges and in the interridge depressions between the river Al'ma and the river Chernaya and on the Inner Ridge east of Belogorsk (Karasubazar). Small patches of trees are found on other sections of the Inner and Outer Ridges and the interridge depressions and valleys.

Broadleaf forests of short-trunked trees, mainly oak, are found between an elevation of 300 and 1,000 feet above sea level. Undergrowth is present in places. Denser and more luxuriant stands of forest are found in the valleys. Some of the trees, particularly the European oak, are suitable for construction timber.

The forests locally restrict maneuverability to roads and small strips of land. According to reports of the German experience during World War II, movement to the east of the fortress of Sevastopol' was restricted by dense undergrowth in the forested areas. The forests, however, offer better opportunity for concealment than the grass or shrub vegetation. In addition, the forests are a local source of material for construction purposes and fuel.

Truck farms, fruit orchards, vineyards, and tobacco plantations are confined to the interridge depressions and basins, and strips along the streams (FIGURES II-147, II-150, and II-151). Much of the lower part of the northern slope of the Outer Ridge has been brought under cultivation, wheat being the predominant crop. In some years protracted droughts have a disastrous effect on the crops. These crops provide some concealment and do not interfere materially with the movement of vehicles.

(d) Trafficability of surface materials (PLANS 6 to 8).—Relatively soft rocks are found in the interridge depressions and basins and in river valleys, whereas relatively hard rocks constitute the bedrock of the Inner and Outer Ridge surface. Bedrock outcrops locally and rock fragments are common in the soil, especially on the ridges (FIGURES II-146 and II-151).

Well-drained, shallow, deep rubbly and loamy soils, overlying consolidated rock, are found on the Inner and Outer Ridge. Especially in the western section of the Outer Ridge south of Sevastopol' and on most of the Inner Ridge, the soils are shallow and poorly developed on slopes where bedrock outcrops. Thick marls are present in the valleys and the outer depressions west of Simferopol'.

Landslides on the steep shoulders of the foothill ridges play a notable role in the relief. The large, collapsed masses usually break up into blocks and small fragments, mantling the surface at the foot of the steep slopes.

Firmly frozen ground occurs on the coast and at low levels only during very cold winters. It is likely that on the average no firmly frozen ground is to be expected at Sevastopol'. At higher elevations soils are probably frozen firm for varying periods during January and February.

Muddy soil conditions can be expected for a few weeks during the spring thaws in March and April (PLAN 6) and for short periods in summer during and following infrequent, heavy, local rain showers (PLAN 7). Where the soils are muddy, most tracked vehicles could move cross-country only with difficulty; wheeled vehicles would be stopped except on the roads. Dry, dusty soil conditions can be expected for long periods during the summer and autumn (PLANS 7 and 8). During periods of protracted drought, the dry and dusty soil conditions last for weeks at a time.

Stone for building material is reported to be abundant in many places. It is quarried from the Inner Ridge limestone.

G. Region G, the Volga-Caspian Desert

(1) Introduction (PLAN 2)

The Volga - Caspian Desert (Region G) extends southeastward from the Grassland Belt (Region E) to the Caspian Sea. It extends across the lower Volga river and forms the southeastern part of the JANIS 40 area. Boundaries of the Volga - Caspian Desert Region are marked by physical features on the northwest and southeast, i.e., desert margin and seacoast, but coincide with the arbitrary boundaries of JANIS 40 on the southwest and northeast. Terrain conditions similar to those of Region G extend across the margins of the area covered by this JANIS into Russian Kazakhstan on the northeast and into Russian Daghestan (covered in JANIS 41) on the south. The Volga - Caspian Desert Region is an irregular quadrangle measuring about 320 miles northwest to southeast, and 250 miles northeast to southwest. The region contains 60,000 square miles, and is slightly larger than the State of Florida.

The Volga - Caspian Desert Region, together with its extension southward into the JANIS 41 area, lies across the path of any movement along the west side of the Caspian Sea and into the Stalingrad, Donets, and Moscow area (PLAN 2). This is significant because one of the passable invasion routes to Central European USSR is from northern Iran via the Caspian Sea and the narrow strip of lowland between its west coast and the Caucasus Mountains (JANIS 41 for detail). The Volga - Caspian Desert Region also would be crossed in any movement along an old nomad invasion route around the north coast of the Caspian Sea. This route also reaches Stalingrad and can be extended west to the Donets industrial areas. (See Chapter IX.)

The Volga - Caspian Desert Region is a low, nearly flat plain. The prevailing flatness of the plain is broken only by the Yergeni hills along the western margin of the region and by minor irregularities such as sand dunes near the Caspian, a flat-topped ridge east of the Volga, and steep banks along the present bed, as well as several abandoned beds of the Volga.

Chief drainage feature of the Volga - Caspian Desert is the lower Volga river. Its numerous channels and great width (7 to 20 miles in flood season) form a considerable barrier across the Region. The Volga has a main channel with depths of 6 to 60 feet and is an important commercial route from the Caspian to Stalingrad and central European USSR. Lesser drainage features of Region G are the numerous shallow marshes along the Caspian coast and small, shallow lakes and ponds scattered over the plain northeast and southwest of the Volga. The Volga - Caspian Desert has virtually no potable surface water aside from that of the Volga, and ground water can be tapped only by deep wells.

Vegetation throughout most of the Volga - Caspian Desert comprises scattered clumps of salt grass with some low, widely spaced shrubs. A belt of nondesert vegetation extends along the Volga. This belt includes grassy meadows which alternate with strips of broadleaf forest. In the delta area, reeds 10 to 20 feet high partly cover the islands.

Chief surface materials affecting trafficability in Region G are silty clay and sandy soils with areas of sand dunes and relatively loose, silty clay and fine sandy soils along the course of the Volga. All of these surface materials are

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FIGURE II-152
MOUNTAINOUS CRIMEA—RELIEF
JANIS 40
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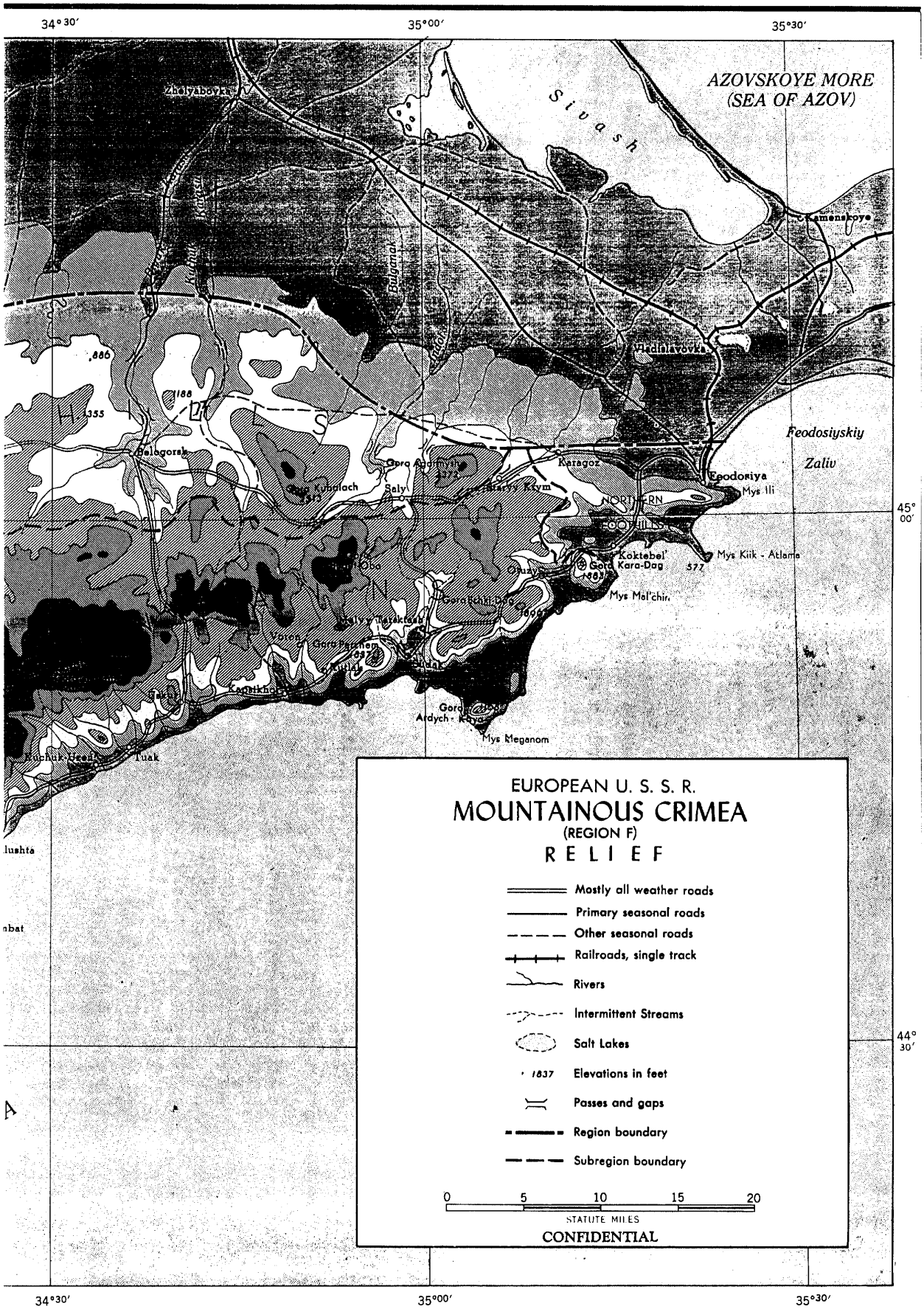

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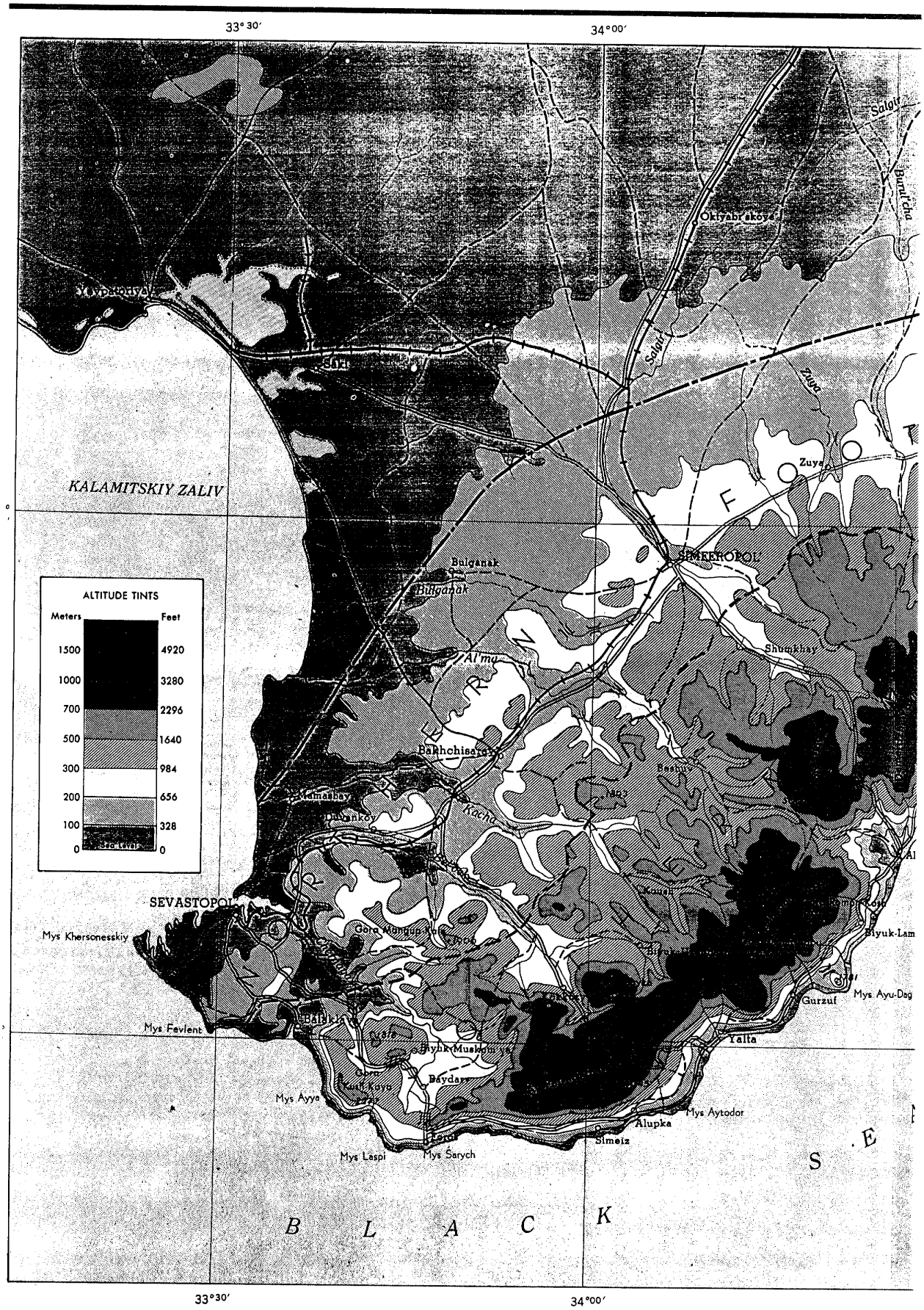

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FIGURE II-153
MOUNTAINOUS CRIMEA—SURFACE CONFIGURATIO
JANIS 40
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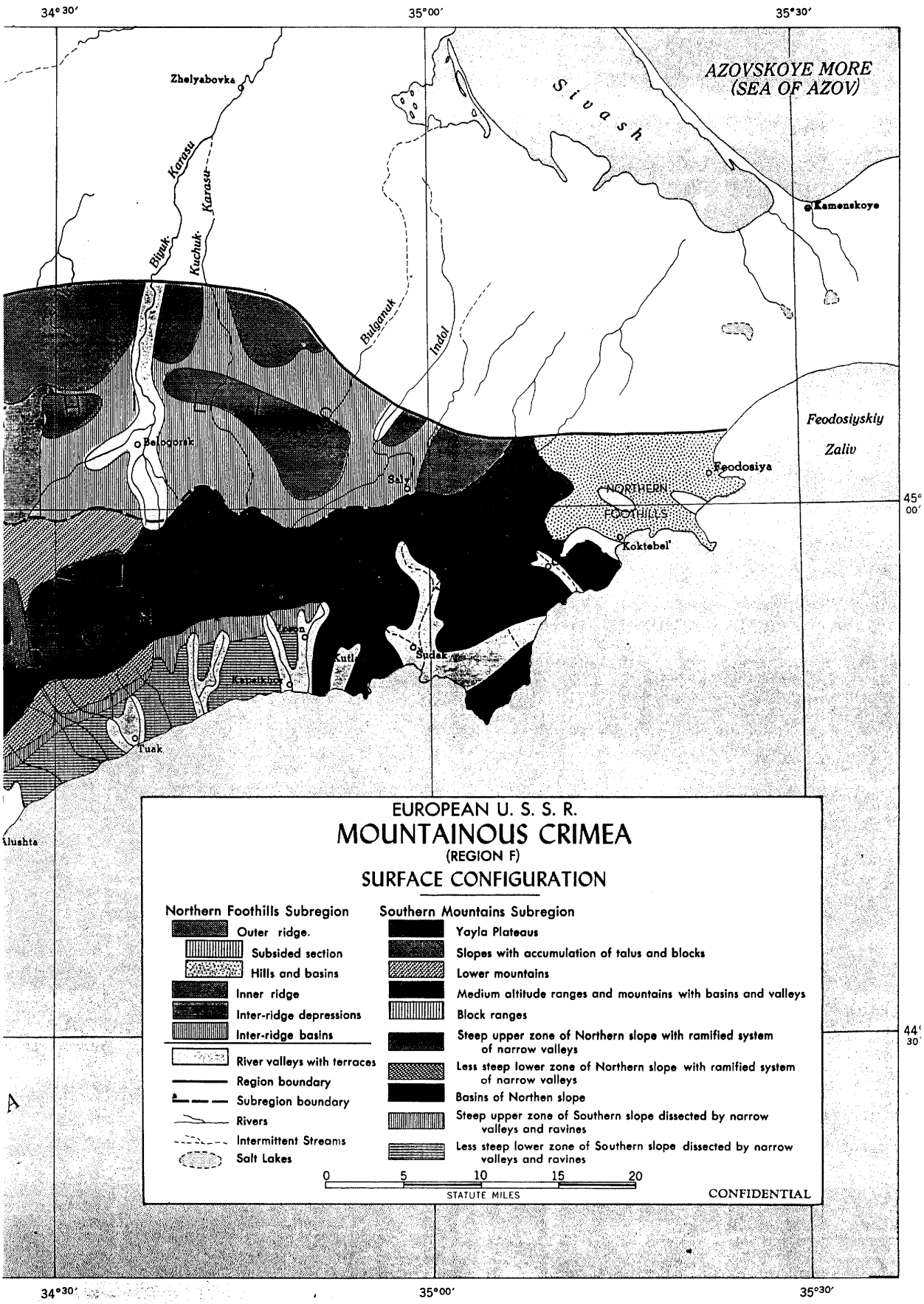

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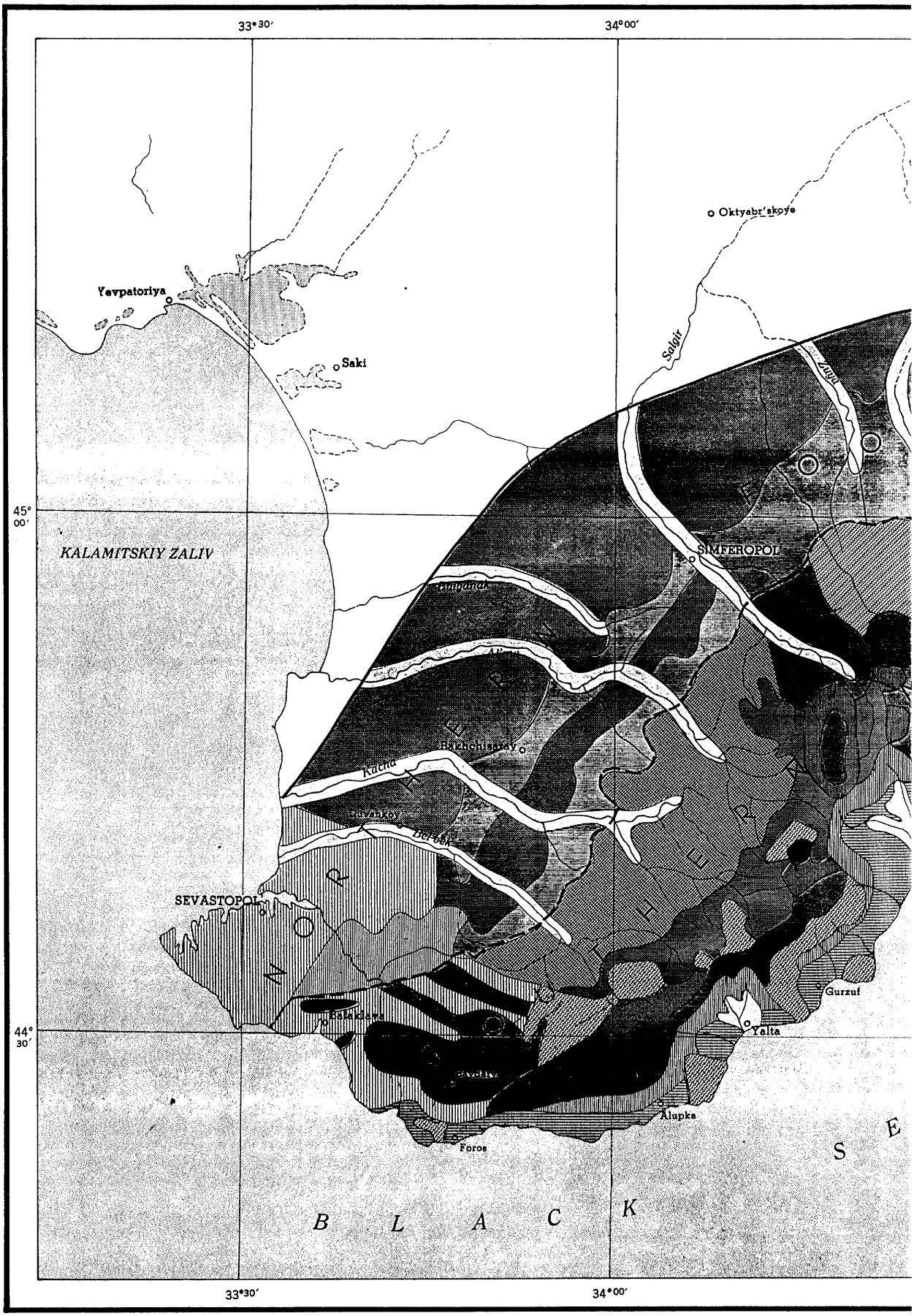

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FIGURE II-154
MOUNTAINOUS CRIMEA—VEGETATION
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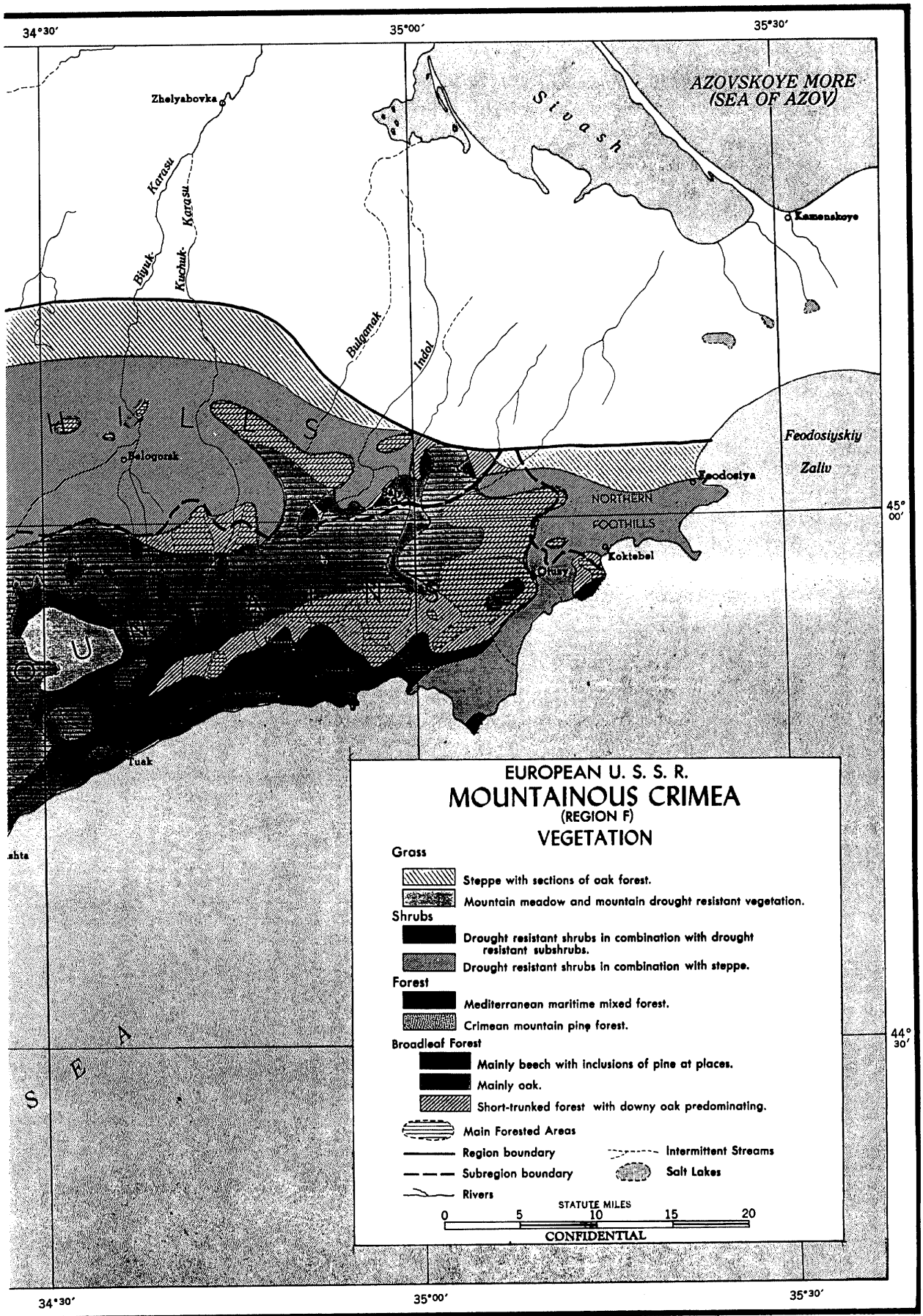

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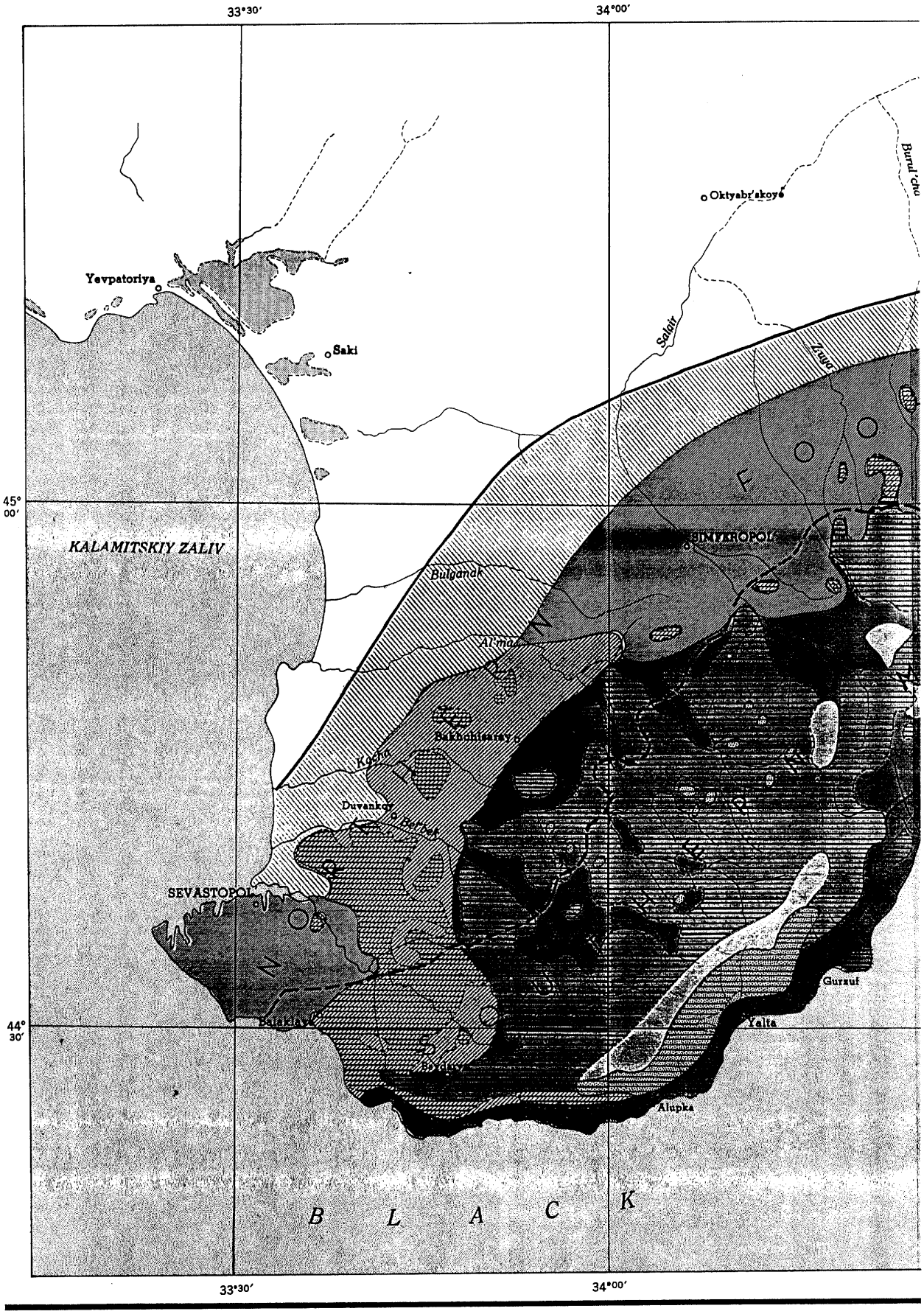

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FIGURE II-155. *A portion of the Volga Valley south of Vladimirovka.*
The contrast is striking between the surface of the Volga flood plain on the lower half of the picture and the Caspian Lowland on the upper half. Numerous islands are enclosed by multiple channels. The relatively steep edge of the Volga Valley is cut by gullies. Note how the roads and trails avoid the Volga flood plain. July 1942.

frozen from late December to early March, but only to a limited extent in the drier soils in the Caspian Lowland. The shallow ice cover on the bodies of water probably is not thick enough to support heavy equipment. During the spring thaws of March and early April, the nearly bare surface of the desert is muddy and almost impassable for two or three weeks Along the Volga, mud caused by floods in May and June adds to the barrier effect of the river at that time. Later in the summer and during fall and early winter, the desert and riverbank surfaces are dry and trafficable except for short periods after infrequent summer showers. During this dry period, great clouds of dust are stirred up by wind or moving vehicles. Visibility is reduced considerably and outdoor activity is almost impossible during dust storms. The Volga - Caspian Desert is divided into two subregions: the Volga Valley and the Caspian Lowland.

(2) Subregion G-1, the Volga Valley

(a) Relief (PLANS 2 and 3).—From the northern border of Region G to the Caspian Sea, the Volga Valley extends northwest - southeast for 270 miles as a long, narrow, shallow depression (PLAN 11). The valley varies in width from about 20 miles near the northern border of the region to only 7 to 15 miles in the central and lower reaches. The delta is nearly 90 miles wide from southwest to northeast.

The part of the Volga Valley included in this subregion lies below sea level and declines gradually from 20 to 30 feet below sea level in the north to 85 feet below sea level in the south where it flows into the Caspian.

The river divides the surface of the Volga Valley into numerous islands and islets of various sizes and shapes; the largest island is nearly 30 miles in length (FIGURES II-155 and II-156). Movement across the river is markedly lim-

FIGURE II-156. *The Volga Valley near Staritsa in winter.*
Staritsa is located on a higher part of the valley floor. The streams and lakes are frozen and the ground is snow covered. At this time light vehicles can cross the flood plain and easily surmount the low edge of the valley. January 1943.

ited by these numerous islands, some of which shift their location and size and may even entirely disappear after a high-water period.

Although the Volga Valley is a nearly level plain, there are significant local variations in the relief. From the northern border of Region G southeastward to Mikhaylovka, the valley bottom contains many narrow, discontinuous channels 180 to 200 feet long, paralleling the Volga. These channels are filled with water during the spring floods. Sand dunes, 45 to 60 feet high, 7 miles long, and averaging one-half mile in width, cover part of the surface between these channels.

South of Mikhaylovka, mound-ridges ("Baer hillocks"), varying from one-half to 12 miles in length, are found on the Volga flood plain. These mounds, generally 600 to 900 feet wide and 18 to 27 feet high, serve as sites for settlements. For example the central part of Astrakhan' is located on one of these mounds. Intervals between the mounds vary from about 600 feet to one mile. Water flows between these mounds during the flood period and converts them into islands.

The delta proper, which begins about 30 miles north of Astrakhan', is a low-lying area composed of numerous islets and islands of various sizes. During flood periods, only the

FIGURE II-157. *A section of the Volga delta.*
View near Il'inka which can be seen in the lower right corner. The Volga delta contains numerous river channels, lakes, marshes, islets, and islands of various sizes. This type of terrain is also characteristic of the old Volga delta along the Caspian coast west of the present delta. Cross-country movement is almost impossible here except when surfaces are frozen firmly. April 1942.

higher portions of these islands and islets remain above water. Maximum elevation of the delta is about 35 feet above the level of the Caspian Sea, but 50 feet below sea level (FIGURES II-157 and II-158). The coast of this vast delta is about 110 miles long, excluding the innumerable coastal irregularities.

It is difficult to map the delta of the Volga and its shoreline, for there are hundreds of low, reedy islands separated by numerous distributaries below Astrakhan'. The channels of these distributaries are constantly shifting (FIGURE II-157). In addition, the level of the Caspian Sea fluctuates a few inches from season to season and with each seasonal shift in level, there is a change in the deposition of debris by the river and shore currents. Since 1929 the level of the Caspian Sea has been lowering slowly.

Steep bluffs border the Volga flood plain, limit maneuverability, and form a barrier to movement across the valley (FIGURES II-155 and II-159). The right (southwest) bank of the Volga which is about 80 feet high at the northern border of the subregion, decreases to 40 feet at Yenotayevsk and is 12 to 30 feet high near Astrakhan'. This high right (southwest) bank is not continuous, however, and between Staritsa and Zubovka the break is about 9 miles long. Downstream or southeast from Yenotayevsk, the high bank again becomes discontinuous and forms detached hills. The much lower northeast bank forms earthen bluffs cut by steep-walled gullies, especially along the northern third of the Volga Valley subregion (FIGURE II-155).

(b) Drainage (PLAN 4).—The river Volga and its valley form a strategic land and ice route in winter from the Caspian Sea inland to Stalingrad and the interior of Soviet Russia. In summer the river is an equally vital waterway. At the northern border of the subregion numerous small channels branch off from the main channel of the Volga. The principal branch is the Akhtuba which flows along the northeastern edge of the flood plain. Numerous interlacing channels wind between the main channel of the Volga and the Akhtuba (FIGURE II-155). Backwater and marshy areas lie along the entire northeastern side of the Volga Valley (Subregion G-1). The river furnishes a source of potable water, after treatment, so that drinking water is not a major problem. No tributaries enter the Volga in its course across the Volga - Caspian Desert (Region G). The main channel of the Volga river within Region G is about 270 miles long. Its usual course is along the southwest edge of the flood plain but it changes direction in many places. The stream is undermining the river bank constantly, especially during the spring high-water stage

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FIGURE II-158. *View of Astrakhan' and vicinity.*
Astrakhan' is located on several islands in the Volga delta. The lower parts of Astrakhan' are protected from the flood waters by a system of walls, since the Volga river rises about 10 feet during the spring flood period. The railroad shown connects Astrakhan' with Stalingrad. October 1942.

(FIGURE II-158) so that the banks frequently cave in and form shallow bars which may become islands. Often, however, these are washed away completely by floods. During each flood period, new channels are dug and old ones filled with mud or sand.

An outstanding feature of the Volga is the great delta which lies at the river's mouth. Actually, over 200 channels flow through a vast wedge of alluvium which projects into the Caspian Sea. From a point about 30 miles north of Astrakhan' where the Buzon branch diverges from the main channel, a succession of large and small distributaries carry the waters of the Volga to the sea, forming a mass of waterways and slow swampy land. This area is somewhat similar to the delta of the Mississippi River, and has similar problems of military geography.

The average gradient of the Volga in the upper half of its course within this subregion is about 0.13 to 0.14 feet per mile. Directly above Astrakhan' it is only about 0.08 feet per mile. Consequently, the rate of flow is not great, but the velocity increases considerably during flood period.

The Volga river is deep in most places. The depth range varies from 13 to 60 feet or more. However, the river is very shallow in the lower delta area and where it empties into the Caspian Sea. A 6-foot channel through the delta below Astrakhan' is kept open by dredging. Numerous critical sandbars and other impediments to navigation are distributed along the course of the river. In ordinary years the minimum depth over most sand bars is 7 feet, but the depth is less than 5 feet in unusually dry years. The width of the main channel varies from 0.25 to 1.25 miles.

The Volga overflows during a spring high-water period, which usually begins late in May or early in June and reaches its highest level in the second half of June. At flood stage, water covers the lower section of the flood plain to a width of 7 to 20 miles. At that time the Volga Valley has the appearance of a lake with islands and hills rising from a few to several feet above the flood waters. Major villages on the Caspian Lowland are located, therefore, along the edge of the valley, or, within the valley, on sites above the level of flood waters. Embankments and drainage works have been constructed to control the flood in some places. For example, the walls and dams which keep flood waters from the lower section of Astrakhan' have a total length of more than 20 miles (FIGURE II-158). De-

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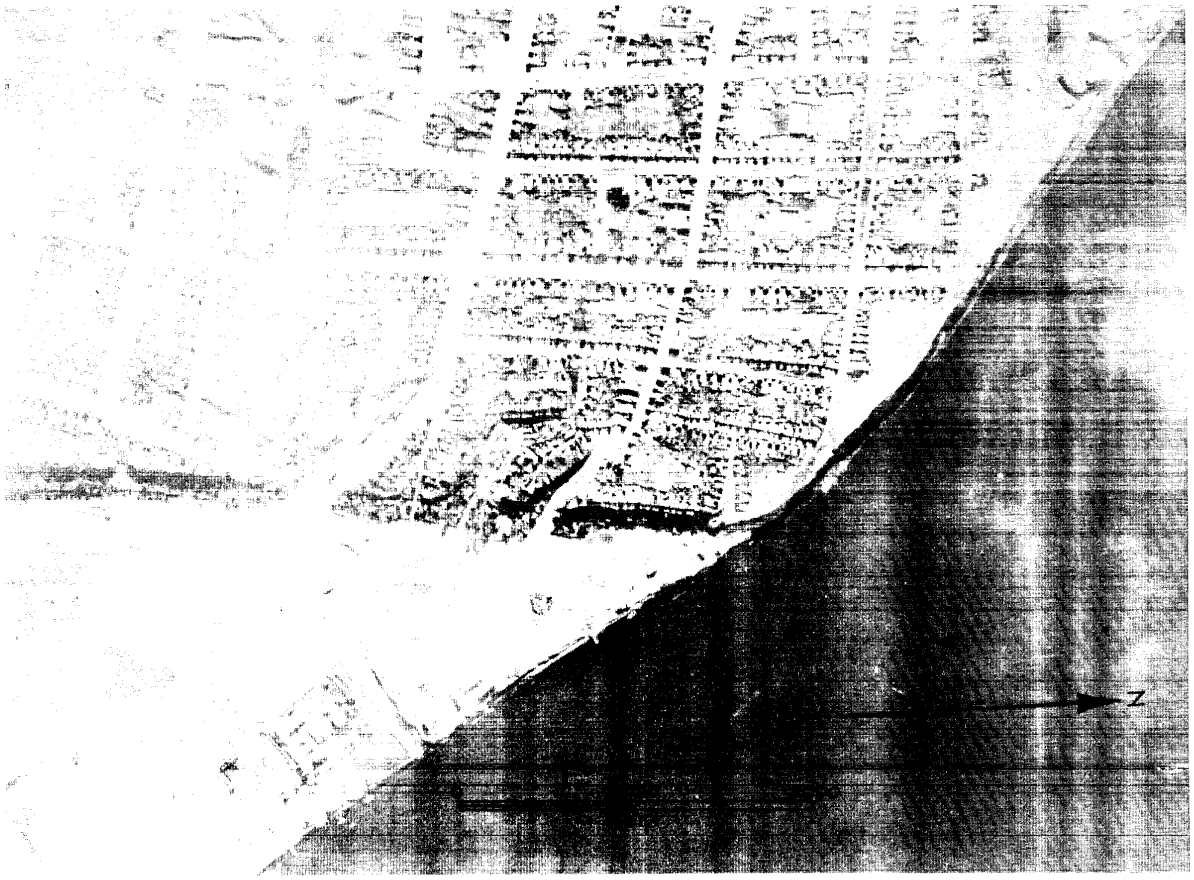

FIGURE II-159. *Kamennyy Yar on the steep edge of the Volga Valley.*
The sharp break between the level of the Caspian Lowland and the floor of the Volga Valley (lower left center) forms a high, earth bluff at this point. Roads have been cut in the cliff leading from the Caspian Lowland to the Volga flood plain (center of view). August 1942.

struction of these embankments and drainage works at times of high water would result in the flooding of an extensive area at Astrakhan' and in the lower delta.

The average rise of the flood water is considerable. The rise is often 38 feet above low water at the northern border of the region, 28 feet above low water at Yenotayevsk, and 14 feet above low water at Astrakhan'. During exceptional floods, however, the water may rise 43 feet above low water at the northern border of the subregion, and 17 feet above low water at Astrakhan', or about 5 feet above normal high crest.

In the summer when flood waters subside, many permanent, large lakes and ponds remain. Some lakes and ponds in the lower part of the valley are salty, and their shorelines may even have a crust of salt. Low-water stage occurs from early September to mid-October.

Solid ice cover on the main channel and its branches begins in December and ends in March (FIGURE II-156). The Volga remains frozen for about 110 days (mid-December to early April) at the northern border of the subregion and 100 days (from the middle of November to the middle of March) at its mouths. During the period of firm ice cover the Volga is closed to boat traffic and its frozen river surface is used as a solid surface highway. Break-up of the ice lasts from 3 to 17 days at the northern border of the subregion but only from 2 to 5 days at Astrakhan'.

For the Volga as a whole, throughout the Volga Valley subregion, the mean duration of navigation is scarcely seven months, from April to mid-November. The river is navigable 50 days longer at Astrakhan' than at the northern border of the subregion, as the upper half opens much later and freezes much earlier than the lower half. Warm weather at times follows the first freeze and again opens the river to navigation by river boats. Even in these unusual warm years, however, the river is closed for boat traffic by mid-December.

The river Volga constitutes the main obstacle within the subregion for cross-country traffic and movement of all types of motor vehicles and motorized units. Except when it is frozen it is a major obstacle to east - west traffic for all types of vehicles, for no bridges span the river, and bridge construction is extremely difficult. The best crossings "reported" by the Germans were located between Kamennyy Yar and Pologoye Zaymishche and in the vicinity

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FIGURE II-160. *Aerial view of the Volga flood plain.*
A typical view of the Akhtuba river in the Volga flood plain, about 15 miles northeast of Kamennyy Yar. Note the numerous abandoned channels, lakes, marshes, islets, and islands. A considerable portion of the area is inundated during the spring floods. Scattered woods cover parts of flood plain, particularly along the water courses. August 1942.

of Astrakhan', where a road and railroad cross the delta (PLAN 11). Ferries serve both road and railroad at the main channel.

During the spring flood season and ensuing muddy period, movement is impossible even with tracked vehicles in the low-lying areas. The delta is passable only along a few roads, but even these are not passable during the spring floods. Normally the marshy areas are passable for all types of vehicles only by road or along narrow strips of drier terrain, such as natural levees and old sand bars. In subfreezing weather, light vehicles can move across the frozen surfaces of the rivers, lakes, and marshes.

(c) Vegetation (PLAN 5).—Abundant ground water supports a vegetation which is luxuriant in comparison to the barren desert-steppe vegetation in the Caspian Lowland (subregion G-2). Grassy meadows partly cover the islands and the low northeastern bank. During the spring flood period most of the meadows are completely inundated but when the flood water subside, the meadows emerge as green oases.

Discontinuous patches of dense thickets of poplar and willow trees, particularly along the edge of the main river channel, mark the water course (FIGURE II-160). Still, the entire wooded area is said to cover less than 5% of the valley land, and the largest individual wooded tracts are less than three miles wide. These woods have little effect on cross-country movement because they can be avoided easily. The woods provide some concealment and could be utilized as a local, limited source of construction material and fuel, both of which are lacking in the desert-steppe to the southwest and northeast.

In addition, dense thickets of reeds and rushes (in some places 10 to 20 feet high), oak, and such bushes as willow and mulberry are densely entwined with hops and bindweed

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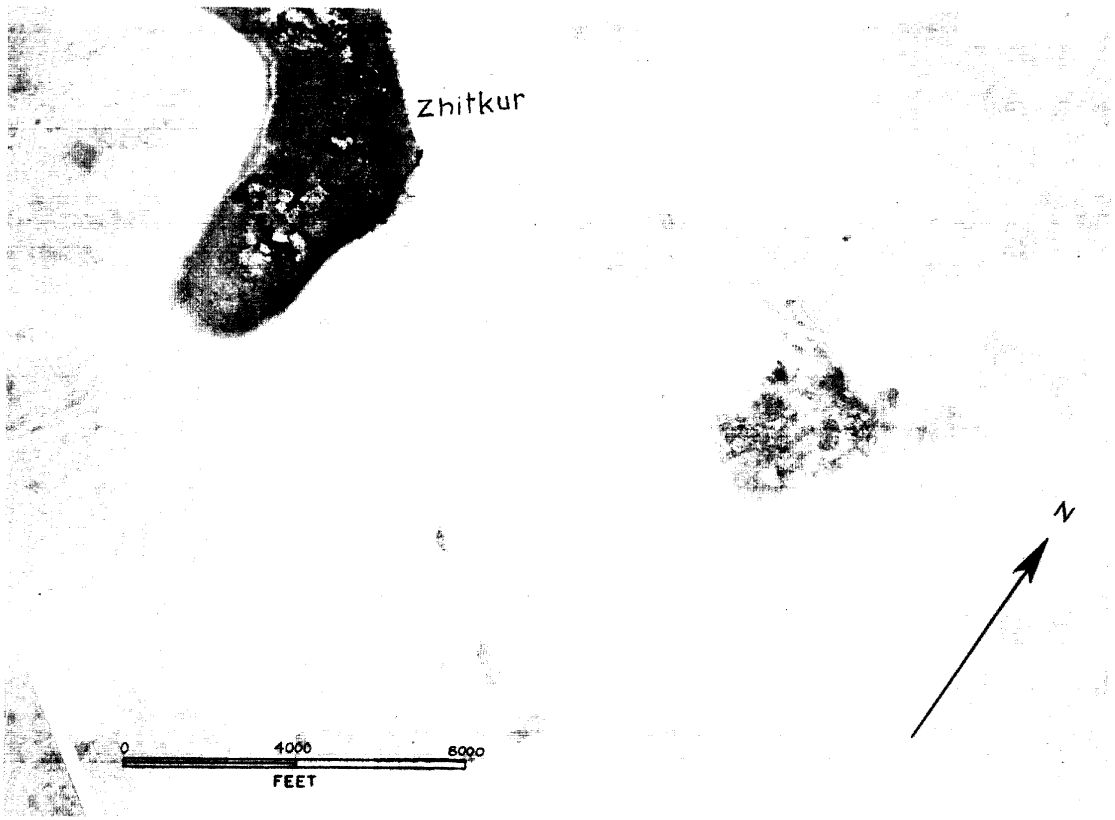

FIGURE II-161. *A typical view of the northern section of the Caspian Lowland near Zhitkur.* Dark areas in the view are salt marshes. The one in the right half of the photograph occupies an old salt lake bed. Unimproved dirt roads extend in all directions across the level surface, but avoid the marshes. October 1942.

and cover many of the delta and flood-plain islands. These thickets provide local concealment. Reed-bordered, winding channels around partly wooded islands are navigable by small boats.

Parts of many islands are devoted to agriculture; hay, which grows luxuriantly, covers a considerable area. On well-drained soils there are orchards, melon patches, vegetable gardens, and recently introduced plants such as soy and castor oil bean, kenaf (a fiber-producing plant similar to hemp), and cotton. Black Astrakhan' grapes are also grown here.

(d) Trafficability of surface materials (PLANS 6 to 10).—From December through March the Volga Valley is trafficable for heavy vehicles over soils which range from fine-textured silts and clays to coarse gravels. Open water and marshes are frozen at this season, and will support light equipment. Reconnaissance is recommended before heavy vehicles are driven onto the ice. Spring thaws set in during the last half of February in the extreme southern portion and in March in the north. Then, as well as during and following a flood period in May and June, muddy conditions completely stop movement of both tracked and wheeled vehicles. Similar conditions exist for a longer period in a narrow 20-mile belt along the delta coast where soils drain slowly.

Inland from this narrow belt the surface is dry and dusty in the summer, except for short periods after local rains in the well-drained areas and for longer periods in poorly drained sections. Dry surface conditions in summer favor movement of all types of equipment. Only minor difficulties are encountered by wheeled vehicles. Severe dust storms originating on the Caspian Lowlands often greatly reduce visibility in the Volga Valley.

Alluvial soils ranging from sands to silty clays cover the subregion, and may be trafficable throughout the year where locally well drained, such as the sandy natural levees near streams. These areas supplement roads as possible routes for movement. Flats adjacent to these levees include both well-drained and poorly drained areas.

Dunes of loose sand which drain rapidly cover parts of the islands in the part of the Volga Valley above Mikhaylovka and restrict movement of wheeled vehicles and foot

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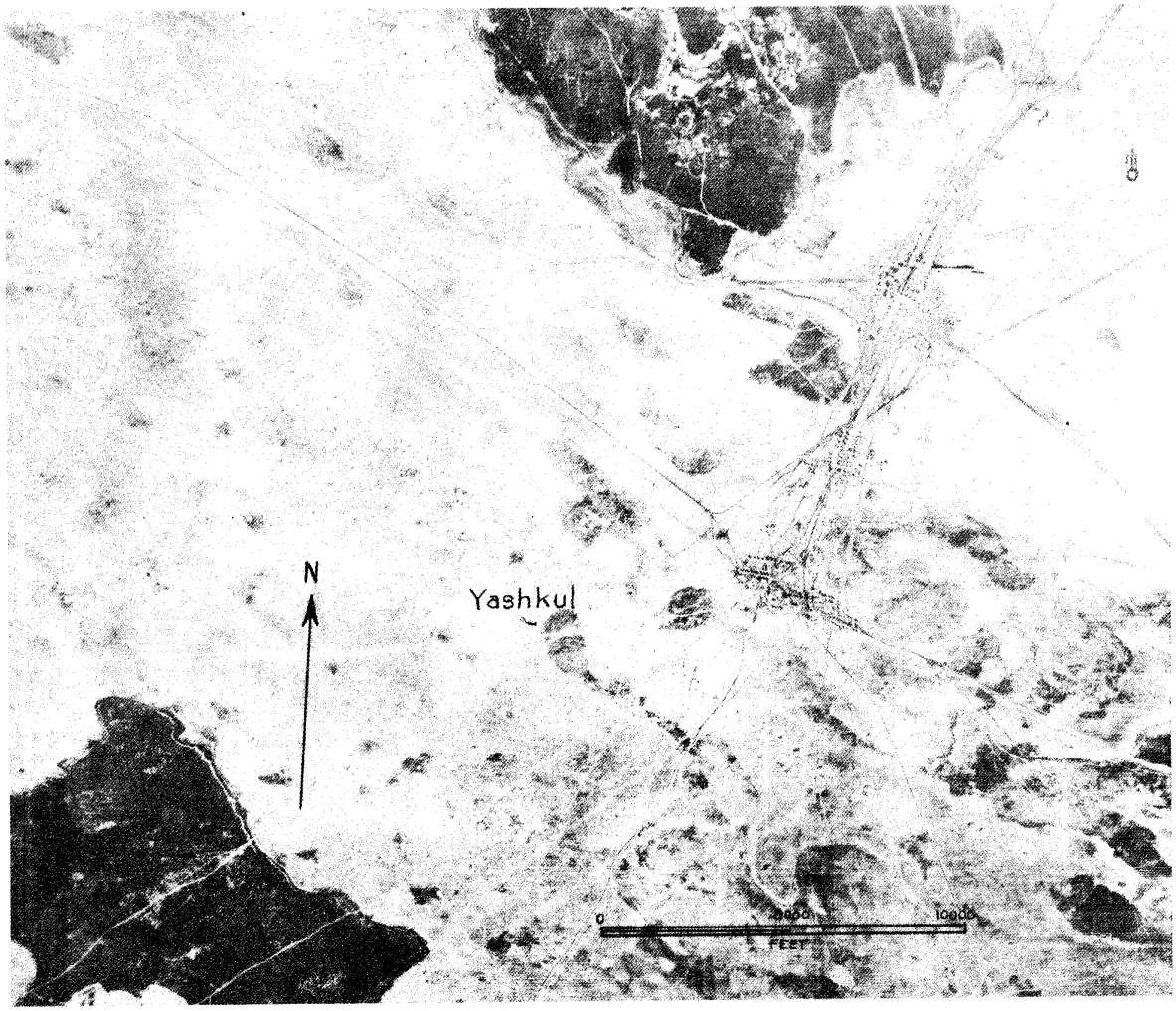

FIGURE II-162. *The Caspian Lowland near the Yergeni hills.*
This typical midwinter view of Peschanoye in the Caspian Lowland near the Yergeni hills shows salt marshes in poorly drained areas. Peschanoye is located on the road which connects Astrakhan' and Stepnoy. The road avoids a large salt marsh, part of which is shown in upper part of view. January 1943.

troops. Footing is best when these sand areas are wet or frozen.

River banks along the Volga consist almost exclusively of clay and sand, and they frequently cave in. These banks are local impediments to movement. A rocky bank exists only at Kamennyy Yar.

Throughout the subregion the surface materials are suitable construction materials. There is abundant clay for adobe brick, and some clay suitable for standard brick is available. In places there is excellent sand for fine aggregate. Sand for coarse concrete aggregate occurs along the Volga. Abundant gravel is suitable for road metal and ballast.

(3) Subregion G-2, the Caspian Lowland

The Caspian Lowland is divided into two unequal sections by the Volga Valley. In general, the surface of both sections of the Caspian Lowland is a low, nearly flat plain. Flatness, however, is modified by local, minor relief features which assume importance in such level and open areas (FIGURES II-161 through II-163).

(a) Relief (PLANS 2 and 3).—The part of the subregion bordering the Caspian lies below sea level (PLAN 11). Elevation gradually increases inland from 85 feet below sea level along the shores of the Caspian Sea to about 100 or 150 feet above sea level in the northern and western parts of subregion G-2.

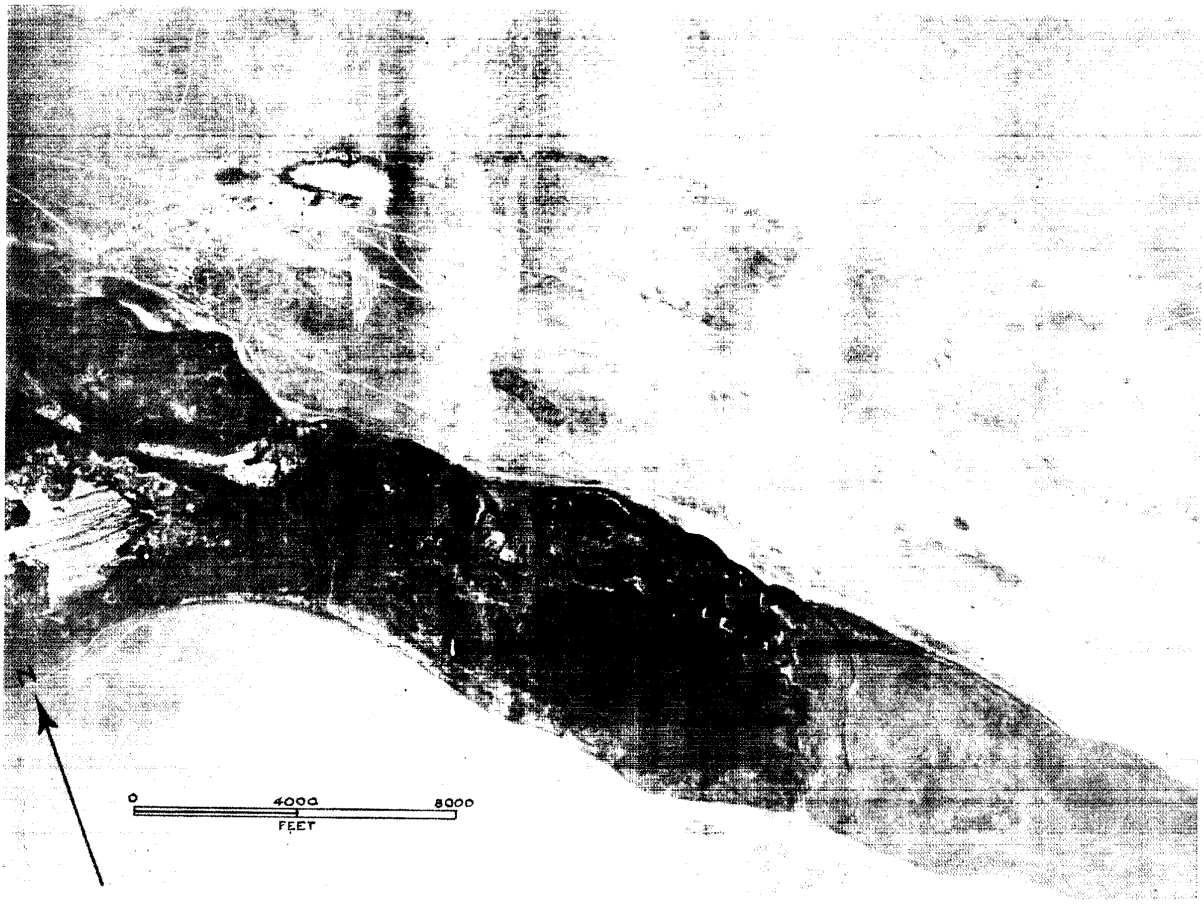

FIGURE II-163. *Ozero Sarpa, one of the Sarpinskiye Ozera.*
Ozero Sarpa is one of the long, narrow, and shallow Sarpinskiye Ozera which occupy a former channel of the Volga river. This view was taken during the low-water period. Note the dirt roads and trails crossing the drier portions of the marshy lake bed. August 1942.

On the western border of subregion G-2, the Yergeni hills and the southern tip of the Pre-Volga Hills rise abruptly above the general plain surface and reach heights of 500 to 600 feet above sea level. Their steep, straight eastern slope trends north - south and rises 150 to 300 feet above the adjacent plain (FIGURE II-164). This east-facing slope is marked by many steep-walled valleys and gullies. All the major valleys trend east - west and are a mile or two wide at their eastern ends, where they open onto the plain. The tops of the Yergeni hills are nearly flat and slope gradually toward the west (FIGURE II-165).

The Volga river formerly flowed along the east foot of the Yergeni hills in a southerly and southeasterly direction and formed a delta in the area of the present lower Kuma river. Later, the lower course of the Volga shifted northward and a new delta with channels trending east - west (PLAN 11) formed to the west of the present delta. Dry washes separated by narrow, parallel ridges and hillocks ("Baer Hills"), about 30 to 50 feet high, mark the former courses of the

FIGURE II-164. *The steep, eastern slope of the Pre-Volga Hills at Krasnoarmeysk.*
Looking west toward the steep, eastern slope and level-topped Pre-Volga Hills. These hills extend southward as the Yergeni hills. The town of Krasnoarmeysk (Sarepta), in the foreground, is about 12 miles south of Stalingrad. Before 1941.

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FIGURE II-165. *The Yergeni hills near Stepnoy.*
A typical view of the almost flat tops of the Yergeni hills at Elista, cut by gullies, ravines, and east - west trending valleys. The dirt roads and trails are mostly on the smoother intervalley areas. The surface appears to be snow covered and streams frozen. January 1943.

river and are well preserved in the present relief of the subregion. Locally the ridges are not always parallel and form an irregular network. The low coast of the Caspian Sea is made very irregular by numerous bays, peninsulas, islets, and islands where the ridges disappear under the water (PLAN 11). Sand dunes of various sizes cover a large part of the Caspian Sea borderland (FIGURE II-166).

The lower Kuma river valley forms the southern border of the subregion and the eastern part of the Kumo-Manychskaya Vpadina (sink), a northwest - southeast trending depression which extends between the Sea of Azov and the Caspian Sea. The sink cuts through the southern end of the Yergeni hills near the southwest corner of Region G.

In general, the nearly flat relief of the Caspian Lowland (Subregion G-2) and the top of the Yergeni hills (FIGURE II-165) is favorable for cross-country movement. The nearly flat surface of the plain favors the hasty construction of roads and airfields. The small hillocks and burial mounds are suitable for observation points. Only in the valleys, gullies, and along the eastern edge of the Yergeni hills is movement limited by steep slopes. Main dirt roads, trails, and railroads avoid the Volga Valley flood plain (PLAN 11). Most of the roads follow a straight line from well to well and are located in the Caspian Lowland subregion. In the vicinity of the Volga river roads run parallel to the edge of the Volga Valley (Subregion G-1) on the surface of the Caspian Lowland. They cross the valley flood plain more or less at right angles by the shortest practicable routes leading to ferry landings.

(b) Drainage (PLAN 4).—Streams in the subregion G-2 are few, and for the most part relatively small; all drain toward the Caspian Sea. Before they reach it, however, they disappear into shallow marshes, sand, or the alluvial

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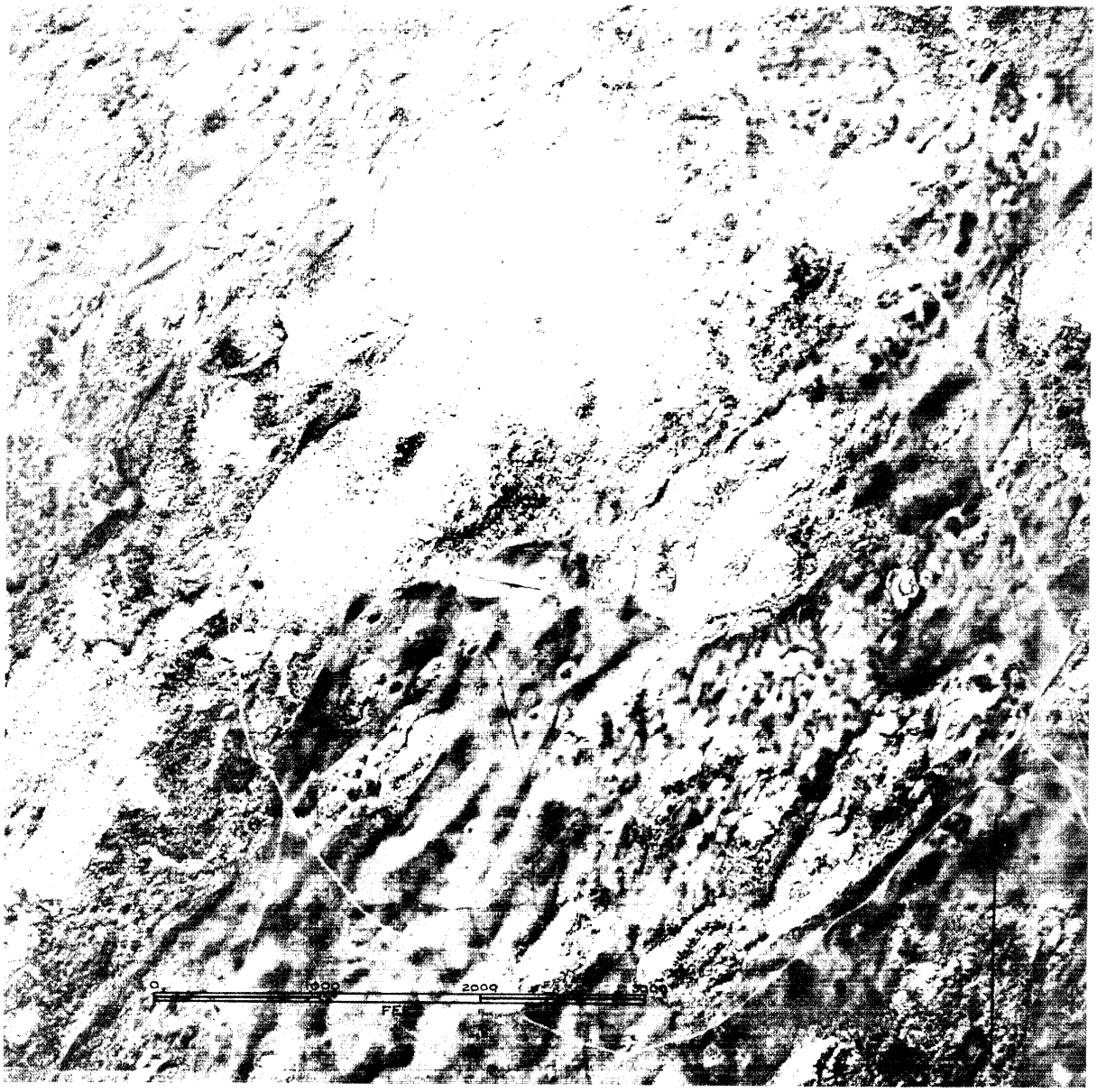

FIGURE II-166. *Sand dunes on the Caspian Lowland northwest of Astrakhan'.*
View is five miles west of Nizhneye Lebyazh'ye. Sand dunes with scant shrubs and grass such as shown in the photograph cover large areas of the Caspian Lowland near the Volga delta. Note how the roads and trails avoid the shifting sand dune areas in center of view. August 1942.

fans in basins where the water evaporates and leaves a crust of alkali or salt. Spring thaws cause flooding of basins and flats. Even the few fairly large and sluggish streams which flow from the Yergeni hills do not reach the Caspian Sea at all times. They are intermittent in their lower courses and in some cases disappear into the sand.

The Kuma river (PLAN 11), at the southern border, is the largest river in the Caspian Lowland subregion. In August and September the channel usually is a series of stagnant pools. Only during rare years of exceptionally abundant water does the river reach the Caspian Sea. More often the Kuma river disappears into sands and marshes about 20 miles from the sea. Because of the shallow depth of the Kuma, there are probably many fords, so the river may constitute only a minor barrier to movement.

The Caspian Lowland has numerous small lakes and ponds, particularly after spring showers, when hundreds of temporary lakes dot the surface of the subregion. This lake water is moderate-to-poor in quality, as intense evaporation causes surface water to be salty. Such shallow lakes dry up quickly and completely in summer. The southwestern and northeastern parts contain most of the salt

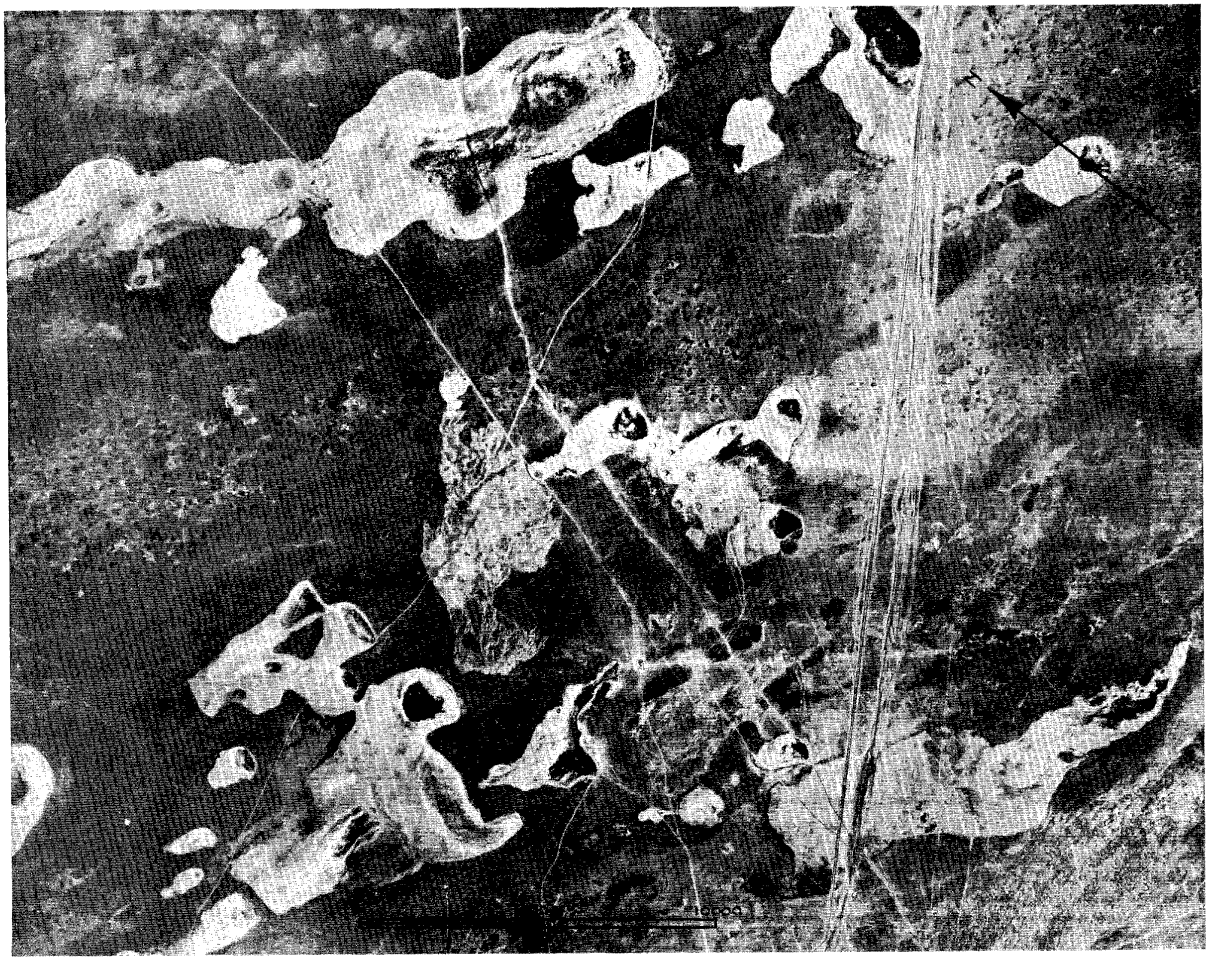

FIGURE II-167. *Salt lakes and salt marshes of the Caspian Lowland.*
View is about four miles southwest of Utta. The dirt roads and trails are very rutty where they cross the salt lake beds and the salt marshes, which are probably frozen. The main trails which parallel the main dirt road indicate ease of off-road movement when main roads may be rutty. January 1943.

FIGURE II-168. *Ozero Baskunchak, a salt lake.*
Ozero Baskunchak is the largest lake in the Caspian Lowland. In the foreground a muddy surface is indicated by the planked road over which the camel-drawn carts travel. Large quantities of salt are secured from this lake. A railroad connects the lake with the Volga river at Akhtuba. Before 1941.

lakes and marshes (FIGURES II-161, II-162, and II-167). The largest salt lakes are Ozero Baskunchak (FIGURE II-168) and Ozero El'ton. Ozero Baskunchak is 66 feet below sea level and is 12 miles long and 4 miles wide. Ozero El'ton is 12 miles long and 3 miles wide; it is 59 feet below sea level. Salt from these lakes is exploited and brought to the Volga by railroad and then is moved by boat or rail to Stalingrad and Astrakhan'. In addition, there are numerous long, narrow brackish lakes west of the Volga delta.

The abandoned stream channel of the Volga along the foot of the Yergeni hills is now occupied by numerous marshes and lakes such as the chain of long, narrow Sarpinskiye Ozera (lakes) (FIGURE II-163). The longest of these lakes is 26 miles long and averages about one mile in width. These lakes are shallow and probably can be forded at many places; they may constitute only local obstacles to east - west movement. Water bodies may be covered by ice from 100 to 110 days during December to March and

probably can be crossed by light vehicles during this period (FIGURES II-162 and II-165).

Numerous marshes, many of which are salt, are located along the Caspian shore, near the river Kuma in the southern part of the region, and in the abandoned channels of the Volga. Some marshes are four to eight miles long. In the spring they may expand in area but contract again during the summer. Similar seasonal characteristics prevail in the partially submerged and marshy portions of the old Volga delta just west of the present one.

Marshes are impassable much of the year for all types of vehicles, except along roads and narrow strips of slightly elevated dry land. In addition, light vehicles can travel across the marshes in any direction whenever the marshes are frozen firmly. The numerous salt lakes and salt marshes near the Caspian Sea are subject to seasonal change and must be reconnoitered before making any large-scale movements in their vicinity.

Potable water is scarce in the Caspian Lowland (Subregion G-2). Much of the water in streams, lakes, and ponds, when available, is too brackish or salty to be used for drinking water or in engines, consequently underground water from wells is the principal source of supply.

Good underground water in most places is located at depths of 150 to 500 feet (PLAN 11). Frequently, water obtained from even deep artesian wells is undrinkable. Water from shallow wells (6 to 40 feet deep) is highly mineralized and undrinkable, although reports indicate that potable water may be had from shallow wells drilled between sand dunes or in the vicinity of the river Kuma. The yield of the shallow wells varies considerably with the season and some may dry up in summer. Some of these shallow wells are reported to yield from one to 10 gallons a minute. However, it is doubtful whether these wells could supply heavy demands. In addition to water from wells, rain and melt water is stored in reservoirs near villages and it is used by the inhabitants to carry them over long periods of drought.

It would be advisable, especially in late summer, to obtain information from natives regarding availability of water. Roads, for the most part, run directly from well to well.

(c) Vegetation (PLAN 5).—The subregion as a whole is a comparatively barren and dry desert. In general, vegetation is not tall enough or dense enough to impede movement or to provide concealment. Some areas with sand dunes or salty soils are bare; others are covered with patches of tufty, and frequently saline, grasses and widely spaced, low-growing wormwood shrubs (FIGURE II-166). The driest and most barren area is a wormwood desert section which borders the Caspian Sea. It has a width of 24 to 80 miles southwest of the Volga Valley and widens to 120 miles northeast of the Volga Valley. Vegetation consists of isolated stands of various species of wormwood, a hard, many-branched shrub which grows from one to three feet high and is similar to sagebrush in appearance. The wormwood generally imparts a grayish-green hue to the landscape. If the wormwood is white, it signifies a clay soil; and if black, a salty soil. These subdued hues change temporarily following a short moist period in the spring, when bright colored flowers spring up over the sand and among the patches of grass and create a landscape of varied and brilliant color.

The scattered wormwood is used locally as a fuel and also is a source of oil used in absinthe. As in all arid and semiarid regions, dried dung of grazing animals is another source of fuel.

Numerous marshy places are covered with a low marsh grass vegetation; the periodically flooded Caspian shore is partly covered with thickets of reeds and canes similar to those on the Volga delta. Elsewhere feathergrasses, a few inches high, predominate in the moister areas inland and in the many depressions. In such grassy areas nomadic peoples are engaged in grazing of sheep, horses, goats, and camels (FIGURE II-169). Lack of fodder, however, becomes serious by the beginning of August, when lack of rainfall causes vegetation to dry. Opportunities for pasturing livestock exist even in winter. Grasses in this dry climate retain their value as fodder in the winter better than in moister climates.

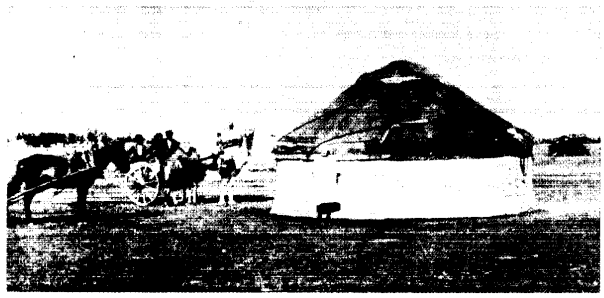

FIGURE II-169. *Desert-steppe vegetation on the Caspian Lowland.* Exact location unknown. The plain surface is covered by sparse grass which provides a scanty pasture for the livestock of the nomadic Kalmyk herdsmen. The trees in the background are probably planted. The Kalmyk hut (*yurt*) is a typical dwelling of the herdsmen. Wherever possible, individual nomadism has been replaced by collective farming or grazing. Before 1941.

Individual nomadism has been replaced by collective farming, in the Yergeni hills and along the northern border of the area where the rainfall is slightly heavier, as well as in a narrow belt along the border of the Volga Valley.

(d) Trafficability of surface materials (PLAN 6 to 11).—The surface material of the Caspian Lowland is characterized by clay and sand (with some gravel), which impart a reddish-brown or gray color to the landscape. Sticky plastic clays, salty clays, and silts are found in a narrow belt approximately 10 to 20 miles wide along the Caspian coast, around the Sarpinskiye and other lakes, and in inland marsh areas. These soils are dominantly poorly drained. Some low-lying areas or depressions become ponds during rainy weather but have a hard salt crust when dry.

Inland, from a coastal belt of poorly drained salt marsh and salty soils, there is a broad belt of well-drained, fine-to-medium textured sands and loamy sands, 120 miles wide in the south and 160 miles wide in the north.

From this belt inland to the Yergeni hills, and to the northern border of the area northeast of the Volga Valley,

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is a belt of soils ranging from silty to heavy clay. This belt is 20 miles wide in the south and broadens to 95 miles in the north in the vicinity of the Volga Valley. These clays and silts absorb water slowly and dry slowly. The surface of the Yergeni hills is covered with deep loamy and clayey soils and is well drained.

In addition, large areas along the Caspian shore, north and south of the delta, are covered with almost bare sand, which drains rapidly when not frozen. In places there are dunes of shifting sand (FIGURE II-165). When wet, the loose sands of the dunes provide better footing than when dry. Trafficability of motor vehicles is restricted in these areas of loose or shifting sand. Rapid deterioration of motor vehicles is likely in such areas.

Salty soils are a widespread phenomenon, for intense evaporation has caused much salt to be precipitated into the soil. These soils are indicated by small areas in which the salt is at the surface during the dry season and which are free from vegetation. There are also many salt pans of various sizes and shapes (FIGURE II-166). During rainy weather these depressions rapidly become muddy.

In summer, the surface materials are extremely dry and dusty. Saline dust storms often occur and may last for weeks at a time, are extremely disagreeable, and render outdoor activity more or less impossible. During such storms, visibility is reduced greatly. Otherwise the dry surface materials in summer favor cross-country movement and offer no difficulties to tracked vehicles but local trouble to wheeled vehicles. It is not necessary to follow the roads in summer.

The ground is frozen from early December to February in the extreme southern section and as late as March in the extreme northern section. Whenever the surface materials, streams, lakes and swamps are frozen, cross-country movement is possible.

The surface of a belt along the shore of the Caspian Sea, extending about 20 miles inland, is muddy for a few weeks during the February thaw; elsewhere the surface is muddy for two or three weeks during the March thaw. This mud period in spring prevents all traffic by wheeled vehicles and limits movement of tracked vehicles (PLAN 10). Movement of mechanized vehicles can be made only on local strips of higher, better-drained land or on the few unimproved roads. These roads rapidly become muddy and rutty in the spring and require excessive maintenance.

After local spring or summer showers, mud conditions will be encountered for short periods in the areas of well-drained sandy soils but for longer periods in areas of moderately drained clay and silt soils, such as those found on muddy and flooded flats. Cross-country movement after showers will be confined to the unimproved dirt roads and will prove difficult or even impossible.

In most places the surface materials can be used for construction. For example, clay is available for adobe bricks, for standard bricks, or for burning to produce artificial clinkers for road metal or ballast. Plentiful sand is available to use as a fine aggregate. In places, sand for coarse aggregate also is available. Gravel is available locally. No building stone is available except in the Yergeni hills, where limestone and marl probably suitable for making cement, are abundant.

23. REGIONAL SUMMARY

The relief, drainage, vegetation, and trafficability of surface materials of each terrain region of European USSR are summarized in TABLE II-1. Terrain regions are shown on PLAN 2.

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TABLE II - 1

REGIONAL SUMMARY

Region	Relief	Drainage	Vegetation	Trafficability of Surface Materials
Region A: Tundra Belt	West of White Sea the surface is dominantly a level-to-hilly, rocky plateau with average elevation above sea level of about 600 to 700 feet, descending precipitously to sea. Along north coast of Kola Peninsula (Murman Coast) are a few narrow beaches. Relief is most pronounced in west where gorges 150 to 300 feet deep separate upland surfaces and make east - west movement difficult-to-impossible. East of White Sea the surface is dominantly a slightly elevated level-to-rolling plain. Minor relief features only, such as sand and gravel ridges and peat mounds in many bogs affect cross-country movement.	Short, deep, rapid streams drain area west of White Sea; long, wide rivers, in many cases navigable during summer, drain portion east of this Sea. Most streams east of White Sea have not been surveyed in detail. Streams are frozen in winter and provide favorable routes, although ice-bearing-capacity reconnaissance is essential.	Dominant flora consists of mosses and lichens. Other vegetation: sedges, dwarf shrubs and trees, berry and willow bushes. All vegetation is low. Cross-country movement is affected only by dense willow growths.	Surface materials include large amount of bare rock, numerous boulders, and glacial materials ranging from heavy clays to light sand. There are extensive marshes and bogs. Winter is favored season for movement, as surface materials usually are frozen firm enough to support most vehicles, but care must be exercised in crossing marshes and peat bogs. Spring and autumn mud periods usually prevent any movement at these seasons except over rock and sand surfaces. Throughout the year Tundra Belt as a whole is not adapted to mechanized warfare as conducted in World War II.
Region B: Northern Forest Belt	Dominantly a wide plain with minor interruptions of low hills and swells in interfluvial areas. Major upland areas lie in western and eastern border areas and in Timan Hills.	Drains primarily to Arctic Ocean. Numerous short and several large streams cross region. Many lakes and much poorly drained land, particularly in western half. All are obstacles to movement when not frozen.	Coniferous forest dominates in north; mixed forest in the south. Stands are generally thick, with little underbrush. Willow and birch thickets border streams in open, grassy meadows and reedy marshes. The few clearings are small. Cross-country movement hindered throughout.	In general, a thin cover of clay, sand, gravel, and boulders. Some boulders large enough to interfere with cross-country movement. Numerous patches of muck soils. Soils and surface waters firmly frozen in winter and readily trafficable.
Region C: Forest and Clearings Belt	Broad, low plain interrupted by clusters of low, round-topped hills in northwest, near Baltic Sea, and by broad banks of low, flat-topped hills in center and east. In the southwest the plain rises gradually to a practically level and slightly dissected high plain along the north side of the Ukrainian Carpathian Mountains (Region D). Some of these dissected areas are rugged except along sides of a few major valleys in south and east.	Major streams such as the Volga, Dnepr, and Daugava (Zapadnaya Dvina) are navigable from late May to October for boats drawing from 3 to 6 feet. Stream ice forms and thickens gradually during late October and November. From mid-December to late March all streams are frozen solid and ice will support men and light equipment. During April and May, ice breaks up, streams rise and valleys are flooded. Swamps and marshes occupy large areas of lowland from Baltic Coast to Kiev and Moscow and eastward along the Volga and its main tributaries. These wet lands are also frozen from December to March but have many thinly frozen spots where heavy vehicles will break through and bog down.	Vegetation consists of forest or woodland, broken by clearings. Forests are largely needleleaf (fir, spruce, pine) in the north but are gradually replaced by broadleaf (oak, beech, poplar) in the center and south. Clearings in northern and western section (Moscow to the Baltic) are small, 0.5 to 2 miles across, and are occupied by either marsh growth (reeds, grass, bush) or by crops (small grains, flax, vegetables). South of Moscow and east of Kiev clearings of several miles across are occupied by crops, chiefly small grains and sugar beets, and relatively small patches of natural grassland. In the extreme southern area trees are limited to strips along valleys and upper slopes of hills.	Trafficability is best on hills and in central and eastern dry plains during late summer (July to October) when ground is dry, and in late winter (December to March) when ground is frozen. Soils of western lowlands along the Volga and near Baltic Sea are trafficable only when frozen (December to March). These wet soils, even when frozen, may give way under heavy loads. All soils are nontrafficable during spring thaws, late March to mid-May, and most soils are nontrafficable during short fall rain-and-freeze season (October to November).

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TABLE II - 1 (Continued)

Region	Relief	Drainage	Vegetation	Trafficability of Surface Materials
Region D: Ukrainian Carpathian Mountains	Most of region has rugged, mountainous terrain. Transverse mountain valleys and low passes provide several relatively easy routes through northwest - southeast trending Russian Carpathian Ranges. Movement outside mountain valleys generally impeded by steep slopes. In narrow Northern Foreland cross-country movement over undulating-to-hilly terrain is relatively easy. Much of Southern Foreland at base of Carpathians is nearly flat.	Generally swift mountain streams with large seasonal fluctuations in volume. Streams widen and gradients decrease as they emerge onto Northern and Southern Forelands. Drainage generally good in mountains, but poor in parts of Southern Foreland and along stream valleys in Northern Foreland, particularly during spring thaws and after early and midsummer rains. Numerous fords across streams in Southern Foreland.	Mountains generally are densely covered with forests to an elevation of 4,000 to 5,000 feet. Large areas of these forests, however, have been destroyed. High, rolling ridges above timber line are covered with low alpine pasture-type grass. Most of both Foreland areas is cleared of forests and land is now used for pasture and crops.	Mountain soils consist of mixed, shallow and deep loams and clays which vary considerably in depth. Bedrock outcrops locally, and rock fragments are scattered through soils. Immediately after heavy rains, forest areas remain saturated; this renders them almost untrafficable. However, run-off is rapid on mountain slopes. In Foreland areas medium- and fine-textured surface soils are nontrafficable for several weeks during spring thaws and following heavy rains or floods of summer. Frequent, heavy snows hinder movement during winter.
Region E: Grassland Belt	Vast, belt-shaped, area of gently undulating plains, rising gradually from coasts of Black Sea and Sea of Azov. Elevations range from sea level to over 1,000 feet with but few steeply sloping areas. Ravines and gullies are common in all black-soil areas and along the usually high, right (western) stream banks, many of which are cliff-like. Left (eastern) stream banks dominantly low and marshy. Relief favors cross-country movement and unlimited deployment almost everywhere, but relief is most favorable to military movement along higher, interstream areas. Few surfaced, but many unimproved, roads. Fair railroad network. Ribbonlike settlements wherever water is available along banks of streams or roads.	Drained by lower portions of numerous large southward-flowing rivers which usually end as estuaries *(limans)*, particularly west of the Dnepr. Considerable areas of flood plain and poorly drained meadowland lie along the left (eastern) banks of streams. Floods are common in spring and spread over these left-bank lowlands. Larger rivers are navigable for river-type craft. Both estuaries and rivers throughout their course in the region are wide and deep enough to obstruct movement. Main transportation lines cross barrier streams at most favorable bridging points.	Varied grasses (2 or 3 feet high in north and shorter in south) the dominant natural vegetation. Trees in gullies and ravines and along streams. Flood plains covered with meadow grass and in places by sparse tree and scrub growth. Some marsh or swamp grass along coastal portions. Most of region cultivated and covered by cereal crops, vegetable or market gardens, orchards, and some cotton and rice fields in irrigated southern portions near coast. Vegetation offers no barrier to movement and very limited concealment. Height, color, and density of vegetation differ considerably from season to season.	Surface materials most trafficable in winter when frozen and when ice on most rivers or streams will support heavy vehicles. Snow cover light and local obstacle only where deeply drifted. Dry surface materials in summer and early fall favor movement in most places. Least trafficable conditions in spring and in late fall when alternate freezing and thawing of soils, melting snow, and precipitation cover ground with mud. Spring thaws and heavy summer rains flood lowland areas and waterlog most low-lying soils.
Region F: Mountainous Crimea	Main Range (peaks over 5,000 feet) extending along south coast and two major ridges (peaks 2,500 feet) paralleling it to north have steep southern sides which channelize movement. Steep slopes limit cross-country movement to small, level expanses confined to a few basins and valleys along steep and rocky south coast, sections of summit of *yayla* plateaus of Main Range, to flat northern slopes of ridges, and to interridge depressions and basins. Main Range can be crossed with difficulty at several places via steep, winding roads. Strategic railroad connecting Sevastopol' and Moscow follows interridge depression and Salgir valley.	Several short, narrow, shallow streams flow from Main Range, which forms the major drainage divide. Streams in east are intermittent. Water supply from streams is limited. High water or flood stage occurs in spring when mountain snow melts, and in summer after a heavy shower. Streams are major obstacles during brief periods of high water; during rest of the year streams are reported to be fordable at many places. Steep banks also impede cross-country movement.	Forests partly cover most slopes of Main Range and restrict movement. Upper, moist slopes have broadleaf forests, mainly beech, and Crimean mountain pine forests. Lower and drier slopes have broadleaf forests, mainly oak, and Mediterranean maritime mixed forest on south coast. Shrubs cover lower and driest slopes in east, north, and west. Steppe and meadow vegetation cover part of north slope of Outer Ridge and most of the top of *yayla* plateaus. Cultivated fields are found in depressions, basins, valleys, and on less steep slopes. Vegetation, other than forest, does not offer important obstacles to movement of vehicles.	Well-drained loamy and/or clayey soils, either shallow or deep, overlie consolidated rock. Rock fragments are common in soil; bedrock outcrops locally. Soils are probably frozen firm on upper slopes from December to February. Soils are dry and dusty for long periods during summer and autumn. Muddy soils can be expected during spring thaw (March and April) and for short periods following local showers. Cross-country movement of tracked vehicles during these mud periods is difficult and movement of wheeled vehicles impossible except on improved and maintained roads.

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TABLE II - 1 (Continued)

Region	Relief	Drainage	Vegetation	Trafficability of Surface Materials
Region G: Volga-Caspian Desert	Volga - Caspian Desert is a low, nearly flat plain. General elevations range from 85 feet below sea level at the Caspian to 300 feet or more above sea level inland. Highest elevations are in Yergeni hills which rise abruptly 150 to 300 feet above adjacent plain. Eastern slope of Yergeni hills has many steep-walled, east - west trending valleys. Numerous islands, channels, and wide flood plain of river Volga are barriers to east - west movement. Bluffs, in places 80 feet high, border much of flood plain. Except for flood plain bluffs and east slope of Yergeni hills, cross-country movement and deployment are favored by the almost level terrain.	Except locally and in river Volga flood plain, drainage does not greatly affect movement in Region G. Streams are absent except for Volga with its numerous channels and for intermittent streams which flow from Yergeni hills and disappear into sand. Many salt lakes dot landscape. Size and number of lakes vary seasonally. High-water period occurs in May and June and low water in summer. Permanent marshes border some lakes and part of Caspian shore. Volga river with its wide flood plain is a major obstacle to east - west movement; it is not bridged. The river is navigable to boats in summer. From December to March in normal years light vehicles can cross on its frozen surface. Potable water is limited throughout entire region.	In general, desert and steppe vegetation of tufted and saline grasses and widely spaced, low-growing wormwood shrubs dominates. Barren areas are found on sand or salty soils. Volga flood plain has luxuriant vegetation consisting of grasses, cultivated crops, dense forest in patches, and reeds in thick stands. Forests and reeds restrict local movement and observation but would provide means for concealment and local source of construction material and fuel. Elsewhere vegetation is not tall or dense enough to impede movement or provide concealment.	Surface materials are most trafficable during winter (December to March) when firmly frozen, and during shorter periods in summer when dry. Occasional, severe, and long-lasting dust storms render outdoor activity more or less impossible. Rapid deterioration of equipment likely because of dust and salt present in air. Surface materials least trafficable during spring thaw period in March, a flood period in May and June, and local rains in spring, summer, and autumn. Except locally, during these periods, movement of vehicles is almost completely stopped by mud. Movement on roads is possible only if roads are maintained.

24. PRINCIPAL SOURCES

A. Evaluation

Terrain data on European USSR are inadequate for the preparation of a completely reliable study on the military geography of the country. A moderate amount of textual material on the JANIS 40 area is available in Russian and German, but much of it pertains to political or economic matters. Scientific studies of terrain features of the country, for the most part, cover only small scattered areas. Dobrynin's *Physical Geography of the USSR* is the most extensive treatise on the country but even this study does not contain the detail required for a JANIS. There are also some French and English publications devoted to the physical nature of the country. In common with the Russian and German works, they lack the detail needed. The most important single French publication is Berg's *The Natural Regions of the USSR;* the most important English one is Gregory and Shave's, *The USSR, a Geographical Survey.* Insofar as has been determined, the publications cited above are reliable.

Various maps were used in the compilation of Chapter II. A detailed appraisal of these maps is given in Chapter XIII, Topic 131.

Air-photo coverage available in Washington is fair for that part of European USSR which was occupied by the Germans. This photo coverage consists mainly of captured German materials. Air-photo coverage for other parts of the country is spotty or lacking.

Most ground photos are close-ups of buildings or people and are of little value for terrain information. Of those which do show terrain features, few are located specifically. Ground photos are most abundant for the German-occupied zones and for the most popular tourist areas before World War I.

Sources, many of which proved invaluable for data on small areas, are listed in Topic 24, B. A detailed study of this list will indicate innumerable gaps in our information that can be filled only when adequate, suitable textual materials, maps, air and ground photographs become available for the entire country.

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