NATURE AND NATURAL RESOURCES OF THE SOVIET FAR EAST

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THE SOVIET FAR EAST (the Far Eastern Territory of the U.S.S.R.) is located in the extreme eastern part of Asia between latitude 42° 18′ N. and 72° N. and longitude 118° 20′ E. and 190° 50′ E. Extending along the Pacific Ocean, the Far Eastern Territory has a sea coast of 22,000 kilometres. The entire northern part of the territory lies in the immediate vicinity of the sea, while the southern part includes certain sections (for example, along the railway line from Khabarovsk to Irkutsk) situated at a distance of 1,000 to 1,100 kms. from the Pacific Ocean and the Arctic Ocean.

The Far Eastern Territory is one of the largest administrative districts of the U.S.S.R.; it occupies an area of 2,607,000 sq. kms. and comprises approximately 12 per cent of the total area of the Soviet Union.

The territory includes both a large section of the mainland (the Maritime district, the Ussuri district, the Amur district, the Okhotsk coast, Kamchatka, Chukotka) and a number of large islands near the mainland. The principal islands are:

1. Sakhalin Is.
2. The Shantarskie Is.—eight islands in the southwestern corner of the Okhotsk Sea, opposite the mouths of the Uda and Tugur rivers.
3. The Commander Is. in the Bering Sea.
4. The Karagin Is. in the Bering Sea opposite the northern extremity of the Kamchatka Peninsula.
5. The Bering and Copper Is. in the Bering Sea.
6. Wrangel Is. in the Arctic Ocean.

The Amur District occupies 29.5 per cent of the total area of the Far Eastern Territory (2,607,000 sq. kms.). The Arctic Regions, the Okhotsk coast with its islands, Kamchatka with the Commander and Karagin Is. and Chukotka comprise 60.2 per cent, the Ussuri District 5.8 per cent, the Primorsk District 3 per cent, and Sakhalin 1.5 per cent.

On the north the territory is washed by the Arctic Ocean and further to the south by the Bering, Okhotsk and Japan Seas.

Stretching for over 5,000 kilometres from north to south, the Far Eastern Territory is extremely varied as regards its natural conditions—separate sections sharply differ in character. However, almost the entire area of the Far Eastern Territory is a seacoast region and therefore constitutes a single geographic unit.

SURFACE

While the contours of the separate sections of the Far Eastern Territory are extremely varied, its surface as a whole is mountainous. Mountainous regions are considerably more prevalent than lowlands.

The largest mountain system of the territory lies along the watershed between the Amur and Lena basins and is known as the Stanovoi Range. The latest works of the academician Obruchev have shown that evidently what we call the Stanovoi (or Yablonovy) Range actually consists of two separate ranges. In places this mountain system attains an altitude of 2,500 metres. The average altitude ranges between 1,000 and 1,500 metres. The highest point is on the watershed between the headwaters of the Zeya River and the streams which feed Lake Tokko. At the headwaters of the Maya River the Stanovoi Range joins the Aldansk Range or Dzhugzhur, which follows the Okhotsk Seacoast from the headwarters of the Maya River to the headwaters of the Okhota River. At times it comes right to the sea, and at others it recedes 30 to 50 kilometres from the shore. Between the Stanovoi Range and the Amur and Zeya rivers lies the Amur-Zeya Upland (average altitude 300 metres). The mountain system of the so-called Stanovoi Range has many spurs, especially in the south where they cover the entire northern part of the Amur Region. The principal spur is the Tukuringa Range, the middle link of the mountain chain which begins at the headwaters of the Olda River on the west and the Buryansk

Range on the east. The western link of this range is called the Yankan and the eastern Dzhagdy. The highest peak of the Tukuringa is Bekeldeul Mountain (1,700 metres). The river Zeya has cut through its foot, forming a mountain gorge. The Bureinsk mountains or Lesser Khingan adjoins the western spurs of the Stanovoi Range. Different sections of these mountains are called Yam-Alin, Dusse-Alin, etc. This range attains an altitude of 2,250 metres. Yam-Alin and Dusse-Alin constitute the watersheds between the tributaries of the Amur and the rivers that flow into the Okhotsk Sea. The Bureinsk Range divides the rivers which flow into the lower part of the Amur River (the Kur and Gorin rivers) from tributaries of the Bureya. The southern continuation of the Bureinsk Range, the Lesser Khingan, extends further south beyond the Manchurian border. For a distance of almost a hundred kilometres between the settlements of Peshkovo and Ekaterino-Nikolsk, the Amur River cuts through the Lesser Khingan, flowing between steep, rocky gorges. The Bureinsk Range has a large spur, the Turansk Range, the watershed between the Selemdzha and Bureya rivers. The space between the Stanovoi Range and its spurs and the Amur River is occupied by the broad Zeisk and Bureinsk lowlands with an altitude of approximately 150 metres. Through them run the Zeya and Bureya rivers. The northern part of the Zeisk lowland, divided off by the Tukuringa Range, is called the Bomnakska.

Between the lower reaches of the Ussuri and Amur rivers on the west and the shore of the Japan Sea on the east lies the Sikhota-Alin mountain region which differs somewhat from the mountain system above described. It is formed by a layer of parallel folded chains. On the north Sikhota-Alin extends to the Amur inlet and on the south to the district of the city of Vladivostok. The western slope of the Sikhota-Alin is quite even, is divided into the valleys of the rivers Daubikhe, Ulakhe, Vek, Iman, Bikin, Khor, etc., and gradually descends in a westerly direction. The eastern slopes of Sikhota-Alin, on the contrary, are comparatively short and descend abruptly to the sea. The Sikhota-Alin mountains reach an altitude of from 800 to 1,400 metres and in some places even 1,800 metres (at the headwaters of the Iman River). The mountains are cut by many cataracts which, at the end of the summer, in the rainy season, flow in large volume.

Sikhota-Alin is divided from the Lesser Khingan and Bureinsk Ranges by the broad Lower Amur lowland which extends in the south into Manchuria and in some places reaches a width of 120 kilometres. This lowland continues far to the south along the courses of the Ussuri and Sungari rivers. The basin of the Upper Ussuri and Lake Khanka contains the Prikhank lowland, one of the most extensive and habitable lowlands in the territory. In the north this lowland extends along the left branch of the Amur—the Gorin—and this part is called the Egoron-Gorinsk; it also extends along the Anguni River.

There are two continuous ranges on Sakhalin Island (the Soviet part): the Western (Kamyshev) Range and the Eastern Range. There is also an isolated mountain on the northern tip, the Schmidt Peninsula. The Western Range is the higher, and in many places along the shore it drops sheer into the sea; the Eastern Range is somewhat smaller and gradually tapers in the direction of the Okhotsk Sea. Between these two ranges lie the broad valleys of the Tym and Poronai rivers. The average altitude of the Sakhalin mountains is 700 metres; the highest peak is Nevelsk Mountain (2,010 metres).

The northern part of the Far Eastern Territory is occupied by several ranges which are a continuation of the Dzhugzhur and Stanovoi ranges: the Kolymsk, which constitutes the watershed between the rivers of the Kolyma basin and the rivers flowing into the Okhotsk Sea, and the Anadyr Range which crosses Chukotka, dividing the basins of the rivers flowing into the Eastern Siberian and Bering Seas. The Chukotsk Range, the Pokulnei, Tiginei, and others have as yet been very little investigated either as to their structure or as to their configuration. The Tangenei Range is divided from the Anadyr Range by the broad Anadyr lowland, along the shores of the Anadyr Bay and the Anadyr River. The Penzhinsk lowland lies southwest of the river, extending to Penzhinsk Bay in the Okhotsk Sea.

The Kolymsk and Anadyr Ranges form mighty arcs with the bulge extending in the southwest. The scarcity of data regarding these mountain systems does not yet make it possible to divide them into independent ranges, although they are not a single range but are made up of a whole number of separate ranges and uplands. Separate peaks of this system reach a height of 2,000 metres. Thus the connection between the Anadyr Range and the Cherskii Range, discovered in 1927, whose spurs extend into the Far Eastern Territory, remains unexplained.

The Kamchatka mountain system bears no relation to any of the mountain systems of the territory. The whole peninsula of Kamchatka, from north to south, is crossed by the Kamchatka or Middle Range, located closer to the western shore. On the north it becomes an upland of no great altitude. The many rivers and streams which run through deep channels down the slopes of the range constitute the complicated network on the coastal plane. The Middle Range is divided by the Parapolskii valley at the narrowest point of the peninsula. Many explorers are inclined to regard the Tingenei Range as the continuation of the Middle Range. The eastern shore of Kamchatka, between the shoreline and the Eastern Range, is covered by small mountain ranges which fall abruptly into the sea and form an extremely irregular coastline with many bays and inlets. Kamchatka is distinguished by its extremely active volcanoes. More than thirty volcanoes, twelve of which are active, constitute a chain on the eastern coast of the peninsula. This chain of volcanoes is a part of the volcanic ring which encircles the Pacific Ocean and crosses through Japan and the Kurile Islands, Kamchatka, and the Aleutian Islands to the American continent. The principal volcanoes of Kamchatka are as follows:

Kliuchevskoi	4,916	metres
Krestovskii	3,900	"
Koriatskii	3,500	"
Kronotskii	3,300	"
Shiveluch	3,200	"
Ushkinskii	2,900	"
Zhupanovskii	2,700	"
Anachinskii	2,646	"
Koshelev	2,400	"

GEOLOGICAL FORMATION

The history of the geological study of the Far Eastern Territory will be divided into three periods. Up to the last years of the 19th Century, mixed expeditions of the Academy of Sciences did most of the work in the Far Eastern Territory, covering vast regions. At the beginning of the 20th Century, the more detailed investigations of the territory commenced, carried on in the main by the Geological Committee. With the constitution of the Geological Committee of the Far East and the unification of the Far East with the Soviet Union, more systematic and detailed geological investigation of the territory was started, conducted by many expeditions of the Committee's geologists and those of the Academy of Sciences and other organizations. But even today the Far Eastern Territory is one of the most backward in the Union as regards geological investigation. Not more than one tenth of the area has been covered by geological survey. Many white spots remain, for example, between Kamchatka and Anadyr, Uda and Amgun.

As a result of geological work in recent years, the general geological structure of the territory has come to life as regards both its mainland and island areas which belong to the Mosozoic and Alpine (Tertiary) folded zones, constituting two geological geo-sinclines, the Verkhoyansk and Nippon, which on the west are adjoined by so-called secondary deposits where folding ceased in the Paleozoic. The Mesozoic and Alpine folding, beginning at the end of the Jurassic or the beginning of the Chalk period and continuing throughout the entire Tertiary period, were superposed on an older system of folding, beginning with the Caledonian. In many places a northwestern direction of the folds is characteristic of the older systems, and a northeastern direction is characteristic of the more recent ones. As a result of such superposition, the pre-Mesozoic forms are for the most part highly dislocated and metamorphosed. Radial dislocations of the earth's crust in the Paleozoic resulted in the intrusion of Paleozoic and Archaic magma, for the most part of granitoid composition, forming large intrusions of igneous rock which subsequently were partially transformed into gneiss. The Mesozoic and Alpine foldings were likewise accompanied by radial dislocations. Along the faults and likewise through the gaps in the folds of the anticlines, magma inclusions occurred, for the most part acid, but in some places basic and ultra-basic. The formation of metamorphosed and partially normal sedimentary varieties of numerous mineral deposits is most likely linked with these intrusions. The wide area of these intrusions extends from the eastern Transbaikalian region to the Okhotsk Sea. But similar formations are also to be found outside this area, throughout almost the entire territory. Partly as a result of heavy folding and partly as a result of an inclination to radial dislocation, older formations in many parts of the Far East were superposed on more recent ones, as may be observed on Sakhalin Island, on the Sikhota-Alin Range, and elsewhere. The role of some disturbances in the geological history of the territory has not so far been fully explained.

The radial dislocations were accompanied by increased volcanic activity which left traces in the form of Mesozoic and Tertiary eruptive masses and the Tertiary tufa layers so common in the southern part of the territory.

Elevation and subsistence during the Mesozoic and Tert[illegible] ages caused the formation of large fields of continental sedimentation, frequently containing coal seams of commercial importance. The intensive folding and radial dislocation altered the original even position of the coal-bearing strata and broke up the coalfields into separate sections.

The Quaternary period is characterized by faults, elevation, and subsidence. For example, along the faults which follow the shores of the Japan Sea, considerable extrusions of basalt occurred. These were especially common in the coastal strip from the southern part of the Ussuri district to Kamchatka, where considerable volcanic activity continues to the present.

II

THE MINERAL RESOURCES

CLOSELY linked with the stratification and tectonic formation of the territory are its mineral resources whose wealth is being ascertained more fully by geological survey work. First in importance for the territory are the gold deposits, both nuggets and sand. The problem of iron ore, which is so important for the entire Pacific coast, is solved in the case of the territory by the large Lesser Khingan deposits. The investigation of the Bureya coal basins has revealed new possibilities as regards fuel in supplementing the deposits already known on Sakhalin Island and in the Southern Ussuri district. Besides the oil on Sakhalin, oil has been discovered on Kamchatka, and on the mainland as well. Molybdenum deposits are already being worked. Mineral resources, stone building material, and various forms of clay are scattered throughout the territory.

Below we examine the principal known mineral resources of the Far Eastern Territory.

MINERAL FUELS

The Far Eastern Territory is amply supplied with mineral fuel which constitutes the prime prerequisite for the industrial development of any country.

Almost throughout the entire area there are coal deposits of different geological ages containing different types of coal. The oil deposits on Sakhalin Island are already well known. Lately oil has also been discovered on Kamchatka. There are tremendous peat beds in many parts of the territory.

COAL

The Soviet Far East has large reserves of mineral coal of the most varied types. The entire scale of coals is represented, from lignites to anthracites, and from humus coals to bituminous shales.

The age of the coal-bearing strata ranges from Paleozoic (Permian) to the highest Tertiary and even the Post-pliocene. But the industrial coalfields belong to Mesozoic and Tertiary deposits.

An extremely interesting and characteristic feature of Far Eastern coals is their "maturity," as compared with their relatively recent age. Many of the recent Far Eastern coals of Tertiary age consist of typical hard coking coals, an example of which is provided by the Sakhalin deposits. Tertiary coals are usually conceived of as immature mixtures of brown coals and lignites. This maturity of Far Eastern coal is largely to be explained by the complexity and the intensity of the tectonic processes to which the coal-bearing strata were subjected in the period of recent Alpine folding, which was particularly intense directly along the Pacific coast, mainly on Sakhalin and Kamchatka where the greatest "maturity" of young coal is to be observed.

Coal formation began in the Far East in the Permian period of the Paleozoic Era, although commercial deposits of this age, similar to the Manchurian, are as yet unknown in the Far Eastern Territory. The most intensive period of coal formation was in the second half of the Mesozoic Era and in the Cainozoic.

Far Eastern coals of Tertiary formation in the territory are easily distinguished by their purity and high quality. A large part of the Far Eastern Tertiary coal is the result of sedimentation in stagnant basins, but there also occur typical estuarine formations: for instance, the rich lower Bureya or Kivdinsk brown-coal district which incidentally is distinguished by the undisturbed horizontal position of the strata, a rare phenomenon in the Far East.

One of the most interesting coal-bearing districts, according to the latest geological findings, is the Bureinsk district, in the northwestern part of the Far Eastern Territory along the upper and middle reaches of the Bureya River. The geological boundaries of the Bureya coal basin have not yet been determined; but roughly it occupies a territory of 6,000 sq. kms., extending along the Bureya River from the mouth of the Umalta River for a distance of 180 kms. The Bureya basin is still in the stage of exploration. In 1934-35, an area of approximately 1,400 sq.

kms. was surveyed, and the coal reserves in that district were estimated at from 10 to 15 billion tons. The richest part of the surveyed district in the Bureya basin is the Urgalsk district near the Baikal-Amur trunk line now under construction and the Khingan iron ore deposits where the location has already been chosen for sinking a mine. The area of the Urgalsk district is about 100 sq. kms., and the reserves have been estimated at approximately two billion tons. The thickness of the seams varies from 1.5 metres to 6 metres, the number of seams from 5 to 12. Coking coal with a comparatively high ash (20-18 per cent), having a calorific power of from 5,400 to 6,000, has been found. The Novosibirisk institute for the artificial improvement of coal by means of washing, succeeded in reducing the ash to from 10 to 13 per cent. The large deposit and convenient location of the Bureya basin give this coal special interest. The Bureyastroi Trust has been organized and has begun to exploit this coal district.

The Bureya basin is apparently part of a vast Mesozoic field of coal-bearing strata. According to available data the Selemdzhinsk, Zeya-Depsk, Bira, as well as the extremely rich Sungari districts (the last one in Manchuria), may be regarded as different sections of this field.

The Selemdzhinsk district, adjacent to the Bureya district, with coal reserves of from 200 to 300 million tons, cannot as yet be of great commercial importance because of its remoteness from the main centers. At the present time coal is only mined here to meet local needs.

The Zeya-Depp Mesozoic coal field in the western part of the Far Eastern Territory, on the middle reaches of the Zeya River, 48 kms. from the mouth of the Depp River, is extremely promising. This district is in the preliminary stage of investigation; but the convenient geographical location, the high quality of the coking coal, and the considerable distribution of Mesozoic deposits, provide good prospects. At the present time coal reserves to a total of 500,000 tons have been surveyed.

Extremely interesting for the character of its coal and the size of the deposits is the Upper Suifun hard-coal district (40 kms. from the town of Voroshilov), part of which lies within the borders of Manchuria near the town of Sanchakou. The coals of this district include hard, bituminous coals and contain layers of a special form of liptobiolite which consists of transparent, reddish-brown bars of resin or gum. They are cemented by a humus-like substance and called "rabdopissite," a name given it by the noted paleologist, Professor A. P. Krishtofovich. Rabdopissite is excellent for dry distillation which yields:

Tar	24.3	per cent
Coke and ash	61.5	per cent
Water	4	per cent
Gas and loss	10.2	per cent

The volatile content reaches 39 to 46 per cent.

Slow-burning, gas-yielding coals, as well as coking coals, are typical of the Suifun basin. The coal reserves of the Suifun district have been estimated at one billion tons, including approximately 34 million tons actually surveyed.

The most thoroughly investigated and one of the most exploited coal beds of the territory is the Suchansk along the Suchan River system and its right-bank tributaries: the Kaban, the Big and Little Sitzoy, 145 kms. east of Vladivostok and 35 kms. from the mouth of the river Suchan and the Gulf of America.

The Suchan coal differs, according to type, as follows: non-coking containing from 15 to 28 per cent and sometimes from 5 to 12 per cent volatile constituents, and semi-anthracite containing from 8 to 15 per cent volatile matters. The calorific value of the coal is from 7,200 to 8,000 calories.

The reserves amount to approximately 60 million tons, and some experts have estimated the deposit of the entire district as 12 billion tons. The deposit has been under exploitation since 1900. At the present time it is one of the main coal centers of the territory.

Among the remaining Mesozoic coal districts, the Upper Amur and Bira may be mentioned. The Upper Amur district lies along the left bank of the Amur River between the villages of Teremykino and Cherniaevo and extends for a distance of approximately 200 kms. The width of the basin is from 15 to 20 kms.; in all likelihood the boundaries of the basin broaden out in the east and west. The coal reserve in this region is estimated at

50 million tons; it consists of coking coal with a high ash content. The Bira coal district (Lesser Khingan) on the left bank of the Bira River, 1.5 kms. to the east of the station Bira on the Amur Railway, was exploited prior to 1921 but was subsequently abandoned. According to recent data, the coal reserves in this region may be set at 50 million tons. The coal can be coked and has a high ash content.

Among the coal basins of Tertiary age (brown coals) within the territory, the following may be mentioned: Tavrichansk and Artemiev deposits, Sakhalin Island, Kamchatka, Kivdo-Raichikhinsk, Khungari, and Mukhon districts. The most exploited are the Tavrichansk and Artemiev deposits. The Tavrichansk bed is located on the Rechno Peninsula, 30 kms. from Vladivostok. It is connected with the Ussuri Railway by a branch running from the station Nadezhdinskaya on the main line. It has reserves of brown coal amounting to approximately 10 million tons. The coal is of high quality, semi-hard, and has a calorific value of from 5,800 to 7,900 calories. The moisture content is from 21 to 27 per cent; ash, to 9 per cent; volatile constituents, 32 to 45 per cent. The Artemiev deposits are located in the coastal region 12 to 17 kms. along the Suchansk branch line which leaves the trunk railway at Ugolnaya Station. The coal reserves are estimated at 129 million tons, including 87 million tons surveyed. The coal has a calorific value of 3,650 to 3,700 calories, moisture content 29 per cent, ash 12 per cent, volatile constituents 42 to 48 per cent. The Artemiev and Tavrichansk deposits, together with the Suchan basin, supply most of the coal to the Vladivostok area. There are large mines on both deposits.

Sakhalin Island has a large coal field. Sakhalin coals vary greatly in quality, ranging from lignites to coking coals; the latter are of the highest quality on the Pacific Ocean. The beds of the western strip are best known as to size of the reserves and quality. This strip extends from the Trambaus River on the north to the Japanese border, and is 200 kms. long and 10 to 15 kms. wide. The reserves are estimated at approximately 117 million tons. Coal from the same stratum has a varying volatile constituency and therefore belongs to different types. Thus coal from the Magachinsk mine has a volatile constituency of 45 per cent, while the same seams 25 kms. to the south, at Aleksandrovsk, have a volatile constituency of from 29 to 33 per cent, and some of them are even coking coals. Further south the veins of the strata contain from 24 to 27 per cent volatile matters and coke well. In general, Sakhalin Tertiary coals begin to be converted into coke with a volatile constituency from 32 to 15 per cent. Although the lower margin of convertibility has not yet been definitely established, it has been ascertained that coal of the Duysk beds with a volatile constituency of from 28 to 33 per cent and Rogatin coal with a constituency of from 15.5 to 18 per cent both coke equally well. The calorific value of the coal is extremely high: from 6,000 to 8,500 calories; ash and moisture are insignificant.

Besides Tertiary coal, Sakhalin has coals dating from the Chalk period; but in most cases these are impure (although there are coal seams sufficiently clean to yield metallurgical coke). Coal-bearing strata extend throughout the island, but the mines are mainly concentrated on the western coast near Aleksandrovsk, owing to the difficulties of transportation in other districts of the island. The main defect of the Sakhalin deposits is their intense disturbance, a result of the general complex tectonic character of the island.

The Kamchatka Peninsula possesses large coal fields, extending for the most part along the northern part of the western shore. The coal is slow-burning with a low ash, a calorific value of approximately 7,000 calories, and a volatile constituency of 32 per cent.

The coal-bearing fields of the western shore are in the stage of investigation. The reserves have been estimated at 130 million tons. At Korfa Bay on the western shore deposits of typical brown coal are being worked.

The Kivdo-Raichikhinsk deposits are located in the southern part near the station Bureya on the Amur Railway. The surveyed reserves of these deposits amount to 580 million tons, including 270 million tons of grade A.

The Kivdo-Raichikhinsk brown coals are characterised by an unusual capacity of separation of the moisture content. Their moisture content is 40.5 to 43.5 per cent; ash, 12.5 to 17 per cent, volatile constituency 42 to 44 per cent, calorific value 3,000 to 3,100 calories. These deposits are already being exploited.

The Khungarisk deposits are in the district of the Khungari River between the village of Troitskoe and the town of Komsomolsk. The coal fields cover an area of 30 sq. kms., and the reserve is estimated at approximately 80 million tons. The Khungari coal is moist (27 per cent); has a comparatively small ash (4 to 12 per cent), and a volatile constituency of 28 to 33 per cent. These deposits may be regarded as a possible fuel base for the town of Komsomolsk; so far they have not been worked.

The Mukhon deposits are located at the headwaters of the Mukhon River in the Khabarovsk region. A reserve of 500 million tons has been ascertained in a surveyed area of 100 sq. kms. The coals are brown with a high volatile (59 per cent) and a large ash (17 to 38 per cent) constituency. The deposits are not being mined at the present time, but in the future they may become the power base of the Khabarovsk industrial district.

Besides the above mentioned coal deposits in the Far Eastern Territory, several coal regions are known which have not yet been sufficiently investigated and are with small reserves: the Nagayan on the Upper Amur, the Gorin on the Amur, the Amuro-Amgunsk on the lower reaches of the Amur, the Rozengardt deposits near Khabarovsk, and a number of others.

It is impossible to describe all the coal deposits of the Far East in the present outline, but it may be pointed out that they are distributed everywhere, not only along the coast and the Amur River, but also along the shores of the Okhotsk and Bering Seas, as well as in the Kolyma District where both soft and hard coal are known to exist. Of the 46 districts in the territory, 20 contain coal deposits.

OIL

Oil deposits in the Far East exist in connection with the Tertiary marine deposits. Two large oil-bearing districts are known so far—Sakhalin and Kamchatka.

The first reports of oil were received from Sakhalin, and the first bidders appeared in 1880 in the oil district in the northern part of the eastern shore of Sakhalin. Subsequently, many attempts were made to develop the oil industry by private entrepreneurs. Several government and private geological expeditions visited the eastern shore. Oil gushers were discovered, also oil and asphalt lakes; but industrial exploitation was not begun. After the Russo-Japanese War, the government decided to open Sakhalin to private mining enterprise, with many restrictions, however, such as the forbidden coastal strip. From that time intense speculation in concessions began. It continued till the Revolution and the occupation of the island by the Japanese.

The Japanese, who badly needed oil for their navy, immediately began developing the oil wells in Sakhalin and gradually began to export oil to Japan.

Before 1925, that is, the time of the establishment of Soviet power in northern Sakhalin, oil was known to exist only on the eastern shore of the island. At the present time, oil fields have been discovered not only along the whole eastern shore but also on the northern extremity of Sakhalin, the Schmidt Peninsula, and on the western shore (the Langri district opposite the mouth of the Amur); and lately indications of oil deposits have been found in the center of the island.

Up to the present time the eastern shore has had the greatest commercial significance. Oil deposits on the eastern shore extend in a strip three to four kilometres from the seashore running from north to south, from Okha to Cape Ratmanov. The most noted deposits are Okha, Katangli, Goronai, Ekhabi, Poromai, Nutovo, Boatasin. The oil-bearing stratum reaches a thickness of over a thousand metres. A heavy type of oil predominates, with a specific gravity of 0.92 to 0.95, rich in heavy fats and black mineral oil. But there is also a light oil with a specific gravity of 0.82 and a high content of benzine and kerosene (up to 32 per cent). The best explored deposits on Sakhalin are at Okha, where the oil industry on the island is now concentrated. The Okha deposits are on the river Okha which flows into the Urkt estuary of the Okhotsk Sea. The deposits are 4 kms. from the shore. They yield a heavy quality (specific gravity 0.93 to 0.95), with a comparatively high yield of light constituents (24 per cent).

Besides Soviet organisations, Sakhalin oil is exploited by the Japanese on the basis of a concession agreement. The oil-bearing deposits on Sakhalin date from the Pliocene and overlie a coal-bearing stratum. Recently, however, oil has been discovered in the Oligocene strata below the coal-bearing strata.

The second oil district of the Far Eastern Territory is Kamchatka. The Kamchatka deposits are now being investigated. The first drilling for oil on Kamchatka was made in 1923 in the district of the Bogachevka River, a tributary of the Kronotskaya River which flows into the Bering Sea. At the present time oil has been located on the eastern and western shores of the peninsula. Favourable geological structures provide grounds for expecting extremely large commercial deposits of oil. At present the most important is the Bogachevsk deposit located 53 kms. from the sea coast and 180 kms. from Petropavlovsk. The oil from these deposits is light, transparent, naphthol-bearing, and containing as high as 78 per cent light constituents. Just as on Sakhalin, Kamchatka oil occurs in connection with Tertiary deposits.

METALS

IRON ORE

As recently as 1931 the Far Eastern Territory was regarded as being extremely poor in iron ores, and the entire geological reserve of iron ore in the territory was estimated at only 20 million tons. But in connection with the industrialisation of the territory, the problem of organising the metallurgical industry in the Far East arose because of the fact that the transportation of the tremendous amount of ferrous metals required by the territory, over many thousands of kilometres of railway, was obviously unprofitable. As a result of this the question of iron ore resources was raised. This circumstance brought the necessity for revising established views on the Far East as a region lacking in large iron ore deposits. Geological surveys were undertaken, and by the end of 1931 iron ore reserves of many hundreds of millions of tons were located on the Lesser Khingan, thereby providing a base for a large metallurgical enterprise.

As a result of geological work in recent years, the territory has advanced to a foremost place among the Pacific countries as regards its reserves, although in 1924 it stood at the end of the line.

The iron ore deposits of the Far East are of the following types in point of origin: (1) old, metamorphosed sedimentary deposits; (2) contact; (3) residuary as a result of the destruction of basalts, rich in iron content; and (4) magnetic sand.

Sedimentary iron ores belong to ancient, apparently Paleozoic, sediments in the coastal area of the sea, i.e., shallow lagoons and estuaries. They are represented by flinty-haematite shales which are horizontally interspersed with flint and chloride clay shales and crystaline limestones. As a result of the action of granite intrusions, they have been transformed into quartz-magnesite and ferric micaceous shales which are easily refined. Such ores were first discovered on the Lesser Khingan in the central part of the territory. The iron ore beds of the Lesser Khingan extend in a narrow strip from north to south between the Trans-Siberian Railway line (Kimkan Station to Tyoploye Lake siding) on the north and the Amur River on the south for a distance of approximately 90 kms. In the district of the headwaters of the Gidzhan river system the strip of the iron ore beds is interrupted by a huge granite mass, as a result of which the iron ore beds are divided into two groups: the southern, comprised of two beds, reaching the Amur, and the northern, including fifteen beds, reaching to the Trans-Siberian Railway line.

The Northern Iron Ore District of the Lesser Khingan

The northern iron ore district of the Lesser Khingan extends from the Trans-Siberian Railway line between Kimkan Station and Tyoploye Lake siding from 45 to 50 kilometres south of the headwaters of the Bidzhan River. The district has an area of 2,000 sq. kms. As many as eighteen different beds of ferrous red and magnetic quartzites are known within the limits of this area. Among these beds the following have been more or less surveyed: the Kimkan, the Kailan, the Ditur.

The Kimkan bed lies on either side of the Trans-Siberian Railway, 200 kms. west of Khabarovsk. The iron ore beds are located 2 kms. north and 8 kms. south of the railway line and from station Kimkan on the west as far as Isvestkov siding on the east. Kimkan ore consists of magnetic and ferrous, micaceous quartzites. The ore has an iron content of approximately 37 per cent. Without preliminary refining the ore is not suited to smelting. Experiments in enriching and conditioning of the ore have demonstrated the possibility of deriving by magnetic separation a concentrate (from 42 to 53 per cent of the crude ore) with an iron content of from 50 to 60 per cent and a low content of harmful ingredients. Preliminary estimates of the reserves of the Kimkan bed indicate a general ore reserve of 170 million tons.

The Kailan beds are located 35 kms. southwest of Birakan Station of the Railway on the southeastern slope of the Sutar Range at the headwaters of the Kailan River. The Kailan ore consists of ferrous quartzite with an iron content of from 55 to 46 per cent. The total geological reserves of ore in the beds is set at 65 million tons.

The Ditur beds are located along the Podrezovsky River, a tributary of the Ditur River south of Birakan Station. The Ditur ore is analogous in structure to the Kailan ore.

The Southern Iron Ore District of the Lesser Khingan

The district extends 40 kms. from the Amur River and lies between the villages of Ekaterino-Nikolsk and Soiuznoye directly north of the headwaters of the Starikovaya River. As many as ten iron beds are known in the district, four of which have been more or less surveyed. This district occupies the second place in the territory in point of reserves (after the Northern Khingan). The geological reserves of ore in the district consist of haematite and ferrous micaceous quartzites. The possibility of tremendous reserves in the southern Lesser Khingan district cause this district to be regarded as an important potential iron ore center.

A negative feature of the ores is their low iron content and the large quantity of impurities, including silica. However, the example provided by the working of the Anshan ores in southern Manchuria shows that the industrial exploitation of the Southern Khingan ores is practicable, and that the district deserves geological and technological investigation.

A second iron belt has been discovered along the western slope of the Sikhota-Alin Range which consists of an extensive system of folds, as a result of which the iron ore deposits have come to the surface. Near the Ussuri Station a number of beds of the same type as those on the Lesser Khingan have been surveyed, and a reserve of 90 million tons of ore has been located. It is quite probable that this belt also continues further to the north in the Amur district.

Another type of Far Eastern iron ores is connected with granite intrusions which, acting upon the limestone, produced typical contact magnetic beds. So far two districts have been located with ores of this type—the Olginsko-Sudzukhin and the Sergeievsko-Ippolitov. The former district is on the shore of the Japan Sea near Olga Bay and along the Sudaukhe River. The geological reserves in this district which include a number of separate beds has been estimated at the present time at 20 million tons, but further geological survey work will in all probability considerably increase the figure. The ores are easily conditioned and contain from 45 to 60 per cent iron.

The Sergeievsko-Ippolitov district is also located in the southern part of the Maritime district, between the Ussuri Railway, Manchurian Branch and the international boundary with Manchuria. The deposits known so far are not very large.

In the western part of the Far Eastern Territory iron ores occur in conjunction with granite. The magnetic beds on the Chichatka River near the railway are extremely interesting. The beds of brown ironstone near the city of Nikolaevsk on the Amur belong to the third type. These beds were formed by the destruction of a basalt layer rich in iron. According to preliminary surveys, there is a reserve of approximately 10 million tons of ore with an average of 40 per cent iron. Recently the opinion has been voiced that these ores are connected with the ancient terraces and are similar in point of origin to the so-called "swamp ores."

The magnetic sands on the coastal strip of the Poset district near the Korean boundary belong to the fourth type. These beds were formed by the destruction of rich magnetic basalts. The reserves are not very large, approximately 1,200,000 tons, with an iron content of 31.25 per cent.

Besides the enumerated beds and districts, there are at many points in the Far East uninvestigated surface indications of iron ores.

MANGANESE

With the organization of the metallurgical industry in the Far East, the question of manganese has been raised. Formerly practically no manganese deposits were known in the Far East. In recent years considerable manganese beds have been discovered northwest of Khabarovsk at Volochaevka Station on the Amur Railway. Indications of manganese ores have also been observed in the Olginsko-Sudzukhin Region and on the Lesser Khingan.

LEAD, ZINC AND SILVER

Deposits of polymetallic ores, lead, zinc and silver, are centered along the coast of the Japan Sea in the neighbourhood of Tetiukhe and Olga bays. The largest of them is the Tetiukhe bed with an ore reserve of 5 million tons which is already being worked by a well-equipped combinat linked with the sea coast by a 35 km. narrow-gauge railway of the heavy type. The working of this bed began in the 1890's. In the beginning an extremely rich oxidized galmey bed was mainly worked, but by 1915 it had been almost completely exhausted, and from that time sulphide ores have been mined almost entirely.

Besides the Tetiukhin bed the district contains several other somewhat smaller reserves which are as yet inadequately surveyed. These include the district of the gulf of Vladimir (the Kholuvai and Ugulovoye beds, where veins of galmey and lead ochres are to be encountered), the district of the Olga Bay where several large lead and zinc deposits have been located, the Kisin lead and zinc mine between the plains of the Tiutikha and Tadush rivers, the Dzhigit district northwest of the basin of the Tiutikha and Okhaba rivers, where lead, zinc and copper beds with a high silver content have been located, the coasts of the Arctic Ocean, the Okhotsk and Bering seas where silver-lead-zinc beds are also to be found (near Cape Stone-Heart, in the Siglan Bay of the Okhotsk Sea).

In point of origin the territory's deposits belong to the hydrothermic metaxomites, that is, were produced by the infiltration of ore-bearing solutions from the magmatic core, replacing the limestones. Extremely interesting from the standpoint of prospecting for polymetallic ores are the Gilyuisko-Urkan and Zeisko-Uchur districts in the western part of the Far Eastern Territory.

Indications of polymetallic ores have been discovered at many points in this district.

GOLD

Gold was mined in the southern Maritime District by the ancient aborigines hundreds of years before the coming of the Russians. At the time when the territory was annexed to Russia, the first form of mining enterprise was the gold industry which began to develop rapidly in the Far East at the close of the 1860's.

The first geological survey of the surface was begun and carried through by the Tzar's government in the gold-bearing regions of the Zeya.

Gold was extracted from the large washes of auriferous sand discovered at the time, almost entirely by manual labor. Many washes were completely spoiled, since only the richest and most convenient sections were selected. Through careless washing of the sands much of the gold was lost with the slag.

At the present time gold extraction has been extensively mechanized: dredges, excavators and hydraulics extract gold from many of the old washes which were spoiled by the old washing methods. Small claims remaining from the old mining are exploited by artels of individual prospectors under the supervision and direction of the state. This form of work gives excellent results as regards increasing the gold yield.

The proper organization of prospecting in the years of the first and second Five-Year Plans resulted in the discovery not only of new washes but also of whole extremely rich gold-bearing districts so far untouched.

RARE AND SMALL METALS

Deposits of rare and small metals—arsenic, molybdenum, tungsten, bismuth, tin, antimony and mercury—occur in connection with oxides in magmatic masses and are therefore located in the same districts as these formations which are for the most part granites, as well as other forms of oxidized magma.

Arsenic beds in the form of quartzy sulphide veins are mainly located along the western slopes of the Sikhota-Alin Range. The Sikhota-Alin as a whole is extremely rich in indications of arsenic ores. Sometimes considerable quantities of arsenic minerals, arsenical pyrites, and less frequently lellingite, are observed in the ores of the Olginsko-Tetiukhinsk district. The most interesting localities for arsenic are the Lake Bolen-Adzhal and the Suchansk districts.

Molybdenum deposits occur in the form of quartz veins with molybdenous limestones, mainly in the western part of the Far Eastern Territory and the Bureya district. The largest deposits that are being worked are the Umaltin, located near the junction of the Umalta River with the Bureya, 200 kms. from the settlement of Chekunda on the Bureya.

Tungsten beds are also mainly located in the western part of the territory, on the upper reaches of the Bureya and Selemdzha rivers. Tungsten in the form of the mineral wolframite is to be found together with molybdenum in the quartz veins of the Bureinsk district, but of special commercial importance are the gold and scheelite deposits in the Selemdzhinsk district.

Recently wolframite has been found together with gold in the northern part of Sikhota-Alin.

Bismuth minerals are found together with gold, tungsten and molybdenum. They are mainly distributed over the western part of the territory in the Bureinsk, Zeisk and Lesser Khingansk districts.

Tin in the form of tinstone (cassiterite) is occasionally found together with gold in auriferous sand. This form of tin has been discovered in the Zeya, Selemdzha-Bureya regions on the Lesser Khingan and Sikhota-Alin.

So far Sikhota-Alin is of greatest interest as regards tin. The district has tin deposits in which cassiterite and stannite often occur in gold-quartz veins, also associated with polymetallic sulphides and wolframite.

Antimony in the form of lustrous masses occurs in connection with the furthest concentrates of magmatic bodies in their effusive phases. Large antimony deposits are found in the western part of the territory. The most important are the Kharginsk in the Selemdzhinsk district and the Solokachin in the western spurs of the Lesser Khingan. In the Lesser Khingan, antimony ores are found in the form of antimonite in quartz-fluorite veins in connection with recent oxidic effusions.

Large commercial deposits of mercury have not yet been discovered in the territory, but they exist in the form of cinnabar in the auriferous sands of the Bureya district and the Lesser Khingan, where they are apparently associated with the young quartzite porphyries. Cinnabar is also found in the Suchansk district on the southern coast. A considerable content of cinnabar has been discovered in the auriferous sands of Yorek Island in the Bureya district.

USEFUL NON-METALLIC MINERALS

GRAPHITE

The largest graphite deposits are to be found in the Lesser Khingan where they exist in the form of graphite shists containing scaly graphite associated with ancient crystaline masses beneath iron ore strata extending along the entire range from the Amur to the Ussuri Railway and farther north. The Lesser Khingan ore deposits contain millions of tons of graphite.

One of the deposits on the bank of the Amur, near the settlement of Soiuznaya, has reserves of graphite shists of approximately 750 million tons, which are accessible to open quarrying. The graphite content of the shists is comparatively low, and the ore requires extensive refining; but on a large scale their exploitation may prove entirely profitable.

In 1935 deposits were discovered in the district of the Ussuri Railway with a fairly rich content of graphite. Besides the Lesser Khingan deposits, graphite deposits are known to exist on the Gil River in the Zeya district, on the Chukotka Peninsula, and in the Maritime District.

DOLEMITE, MAGNESITE, FLUORIDE

Large deposits of dolemite and magnesite with a large content of magnesium carbonate are associated with the metamorphosed Paleozoic iron ore strata age in the Lesser Khingan. Considerable quantities of fluoride occur in the Boguchansk antimony beds. In addition, fluoride veins are known to exist in the neighbourhood of Ippoloitovka Station on the Ussuri Railway.

BUILDING STONES

In view of the extensive construction going on in the Far East, the abundance of various stone and building materials in the territory should be regarded as of prime importance. There are large deposits of crystaline limestones and beautifully colored sculptural marble. The beautiful variations of granite and granite-porphyry provide splendid facing material.

Recent post-Tertiary layers of basalt are also widely distributed in the Far Eastern Territory. Light vesiculars and tufa provide excellent material for the manufacture of light- and heat-resisting building substances. There are many types of clay in the district, including kaolins of high quality. There are large reserves also of high-quality pumices on the Kamchatka Peninsula in the neighbourhood of the active volcanoes.

There is a large cement works in the town of Spasskoe, equipped according to the latest standards of technology and amply supplied with raw material.

MINERAL SPRINGS

Mineral springs are widely distributed over the Far Eastern Territory. The well-known Ladursk Sulphur Springs with temperatures as high as 73° C. are in the western part of the territory on the Lesser Khingan. A large well-appointed health resort has been built in the district. It is connected with the railway by a beautiful automobile road. The Anninsk Hot Springs in the neighborhood of Nikolaevsk on the right bank of the Amur are well known. Along the western slope of Sikhota-Alin, there are a number of sulphur and alkaline-carbonic acid mineral springs and muds—apparently associated with a tectonic fault that parallels the range. These include the "Lastochka" spring which is similar to the Caucasian Borzhom, and the Ussuri or Shmakovka carbonic acid springs whose water is listed as first-class, according to the Palmer classification. Health resorts have been organized at all these springs. Because of contemporary volcanic action, the Kamchatka Peninsula abounds in hot springs on the western shore which deserve mention.

Besides the mineral springs enumerated, there are many others in the territory, such as those on the western slope of the Sikhota-Alin in the southern part of the Lesser Khingan and those on Sakhalin Island.

III

CLIMATE

THE MAIN features of the climate of the Soviet Far East are caused by the interaction between the greatest continent in the world, Asia, and the greatest body of water in the world, the Pacific Ocean.

In winter, as a result of the intense cold, the atmospheric pressure over the continent becomes very high. The center of the high-pressure area is in Mongolia, southwest of Baikal. In January the pressure here attains the highest figure in the world of 778 mm. and more, while at the same time low atmospheric pressure prevails over the Pacific Ocean. At the center of this area, the Kurile Islands, the atmospheric pressure in January reaches 748 mm. and less. As a result of such interaction of the atmospheric pressure in winter time, the cold air circulates off the continent towards the ocean. The direction of the winds is in specific instances conditioned by the direction of the mountain ranges and river valleys. The greatest wind velocity is attained where the mountain ranges running parallel to the coast line are intersected by valleys. One such illustration is the Vladivostok district.

In summer, on the contrary, the steppes and deserts in the center of the Asiatic Continent become extremely hot, and therefore the atmospheric pressure here becomes low. The center of this low-pressure area is also in Mongolia. In July the pressure reaches 752 mm. and lower. During this period the sea is considerably colder than the land, and the atmospheric pressure over the Pacific Ocean rises to over 767 mm. in the northern part. Consequently, in summer time the wind blows from the Pacific Ocean to the Continent. Monsoons not only take the form of a regular shifting of the winds but are accompanied by a peculiar combination of all other climatic elements. In the southern half of the Soviet Far East, approximately up to 60° N. lat., the influence of the summer monsoon penetrates quite far inland. Further north it is also to be felt, but only along the narrow coastal strip. Kamchatka has a system of monsoon winds independent of the continent, which in the winter blow from the inland parts of the peninsula to sea and in summer time from the sea to the interior.

WINTER

Winter under the climatic conditions typical of the continental sections is distinguished by lack of wind or very slight wind, a clear sky, an abundance of sunshine, low precipitation, a small snowfall, and bitter persistent frosts. All of these features are most pronounced in Yakutia and Transbaikalia. In Transbaikalia not more than 10 mm. of precipitation falls on an average during the winter, and the average snow cover for ten years does not exceed 20 cm. In these places where perpetual ground frosts do not exist, the soil freezes in winter to a depth of 3 metres and more. Further east the temperature in many places is fully as low as in Transbaikalia: in the northern part of the Zeya River basin frosts of minus 55° C. are recorded, and frosts of 50° C. extend as far as the mouth of the Amur. The Zeya River basin has a winter climate which is very similar to that of Transbaikalia. But further east, nearer the ocean, the temperature increases, as does also the precipitation, the cloudiness, and snowfall. The wind velocity increases, and calm spells are less frequent. In the central part of Kamchatka the winter is continental in character, with frosts as low as 50° C. But at the same time there is a heavy precipitation and a deep snow cover (one metre and over), and heavy snow storms are a frequent occurrence. Winter thaws are also possible. On the western shore of the peninsula the cloudiness is greater and the winds are stronger, while on the eastern shore there is considerably more precipitation. The snow cover is usually more than a metre thick, and in some cases reaches three metres (Petropavlovsk, March 1916). In Petropavlovsk the ground only freezes to a depth of a few centimetres in the winter time.

The winter, on the more northerly coast of the Bering Sea and the Arctic coast, is mainly characterized by strong prevailing winds. In Lavrentiya Bay the mean velocity of the wind during the three winter months reaches almost 19 metres per second, with blizzards twenty-one days in the month. Lesser, but nevertheless considerable, velocities have been observed at Wellen (10 metres per second) and Anadyr (6 metres). Inland the wind velocity rapidly drops (Markovo, 1.4 metres per second); and there the winter is continental in character, with frosts as low as 60°. Northerly winds prevail along the coast, but southerly winds also frequently occur. In the latter case even warm spells are possible. It sometimes happens that in the period from December to March strong winds blow several days in succession at a temperature of 25 to 29° C., which makes travelling extremely difficult. For instance, in December, 1927, winds with a velocity of from 18 to 40 metres a second continued unceasingly for twelve days. Strong winds result in equally strong snow blizzards which are locally termed "purgas". At Wellen and Lavrentiya Bay purgas rage half of the time. There are two forms of purgas, northern and southern. The first is accompanied by heavy frosts with a clear sky and takes the form of dry snow being blown from place to place. During a southern purgas snow falls, the sky is overcast, and the atmosphere is comparatively warm.

The very heavy frosts in calm weather in the continental parts of the territory are much more endurable for man than the lesser cold along the coast with the heavy winds.

SUMMER

Summer in the monsoon region of the Far Eastern Territory is the exact opposite of winter. As early as April, the pressure in the southern part of the territory falls considerably, and in Vladivostok the wind begins to blow from the sea (from the southwest). In May sea winds begin along the entire coast, including Okhotsk. From then on the moisture of the sea air begins to penetrate further and further inland. The character of the weather accompanying the summer monsoon develops gradually and consistently. First of all, changes begin in the upper reaches of the atmosphere and in the immediate vicinity of the ocean. Later these changes penetrate deep inland, and the maximum time is required for the changes to affect the lower strata of the atmosphere directly in contact with the earth's surface.

January is the coldest month of the year. In February the temperature begins to rise considerably, but at the same time the sky becomes clearer; precipitation drops sharply and reaches the minimum for the year. In March cloudiness increases as well as precipitation. But the relative humidity of the air continues to decline in April and even in May. The latter month is usually the driest in the year. Meanwhile the upper layers of the air continue to absorb moisture brought in from the ocean, and cloudiness increases. In the Zeya River basin at the end of May and the first half of June cloudiness is greater than at any other time in the year, though the air is drier than at any other time, and precipitation is comparatively low. In some cases the humidity falls to 8 per cent, although in general from 70 to 75 per cent of the sky is overcast. Therefore, June, and to some extent May, also have less direct sunshine than any other time of the year. In addition, April, May and the beginning of June have the strongest winds in the year. The winds blow partly from Mongolia and in such cases are dry and frequently laden with a very fine dust which curtains the sky.

The soil, frozen deep during the winter, and the surface of the eternal snow melt slowly. The cold soil, the dryness of the air, the strong wind, and insufficiency of precipitation, as well as the frequency of nocturnal frosts, make spring on the continental part of the territory unfavourable to the growth of vegetation.

With the second or the third ten-day period of June, a considerable layer of atmosphere over a wide area becomes so heavily impregnated with water vapor that the latter easily condenses and marks the beginning of considerable monsoon rains. The rains increase up to the beginning of August when the heaviest rainfall occurs at most points on the continental part of the territory. In August the atmosphere reaches the greatest saturation for the year near the earth's surface, but cloudiness notably decreases.

Rains facilitate more rapid melting and warming of the soil. At the same time moisture and warmth create almost ideal conditions for vegetation. Trees, grasses and grains begin to grow rapidly and in the comparatively short summer can attain a large growth and secure a large harvest.

TABLE 1. MEAN TOTAL PRECIPITATION
(from 1911 through 1930, in mm.)

Place	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Vladivostok port 43° 17′	10	16	31	35	62	89	96	120	145	60	58	22	744
Olga 43° 44′	21	15	32	39	39	59	110	152	120	70	57	27	741
Voroshilov 43° 53′	6	5	14	28	54	69	86	98	112	42	29	10	553
Khabarovsk 48° 28′	6	5	8	20	48	70	103	109	76	32	17	10	504
Blagoveshchensk 50° 15′	4	6	7	22	36	106	113	100	63	20	13	7	497
Aleksandrovsk on Sakhalin 50° 44′	51	16	29	28	38	42	76	83	90	65	43	59	620
Okhotsk 59° 21′	2	2	5	11	27	44	65	74	65	26	6	3	330
Petropavlovsk on Kamchatka 53° 00′	90	56	83	64	41	44	83	85	68	66	50	70	800
Bering I. 52° 12′	52	36	40	24	21	25	47	55	58	54	50	48	510
Anadyr (Novomariinsk) 64° 45′	9	6	6	5	9	22	35	43	28	15	7	8	193

TABLE 2. MEAN MONTHLY ATMOSPHERIC TEMPERATURE
(from 1911 through 1930, in centigrade)

Place	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Vladivostok port 43° 17′	−14.0	−9.7	−3.0	4.7	9.7	14.4	19.3	21.5	17.0	9.6	−0.6	−9.7	4.9
Olga 43° 44′	−12.7	−9.1	−3.7	3.5	8.5	13.0	17.7	19.3	14.2	6.8	−2.1	−10.1	3.8
Voroshilov 43° 53′	−21.0	−16.2	−6.4	4.7	10.8	15.8	20.3	21.1	14.9	6.7	−4.8	−16.3	2.5
Khabarovsk 48° 28′	−22.0	−17.4	−9.0	2.7	11.4	17.3	21.2	20.5	13.8	4.9	−8.1	−18.7	1.4
Blagoveshchensk 50° 15′	−24.0	−19.0	−9.4	2.8	11.7	18.1	21.9	19.8	12.1	2.3	−11.5	−21.9	0.2
Aleksandrovsk on Sakhalin 50° 44′	−17.4	−15.0	−8.6	−0.4	5.5	11.1	15.6	16.8	12.1	4.8	−4.8	−13.2	0.5
Okhotsk 59° 21′	−23.5	−21.2	−14.0	−6.0	0.9	6.1	12.0	12.6	7.9	−2.7	−14.5	−20.8	−5.3
Petropavlovsk on Kamchatka 53° 12′	−8.9	−8.7	−6.2	−1.9	2.2	6.7	10.5	11.9	9.2	3.9	−3.0	−7.8	0.7
Bering I. 52° 12′	−3.8	−3.9	−3.1	−0.9	2.1	5.3	8.5	10.6	8.7	4.3	−0.1	−2.9	2.1
Anadyr (Novomariinsk) 64° 45′	−22.2	−21.3	−20.1	−14.3	−3.4	4.7	10.7	9.8	3.9	−5.0	−14.4	−21.2	−7.7

From August on the amount of precipitation decreases. It continues on a fairly high level in September, in some places reaching the highest monthly figure for the year, but in October it drops sharply to a small amount; and by this time the moisture of the year also decreases considerably, reaching the second yearly minimum. But cloudiness decreases even further, so that October and part of September are dry, clear, and still fairly warm months. The winds are stronger, however, than in the preceding or coming months.

Along the banks of the Japan and Okhotsk seas and the Tartar Sound summer is colder and damper than inland. It begins later and ends later. The spring and summer dry period is either absent or very slightly expressed, as compared with the inland parts of the territory. But a special feature of summers on the Japan and Okhotsk sea coast are the fogs, a result of the mingling of cold and warm bodies of air. From May to August from one-third to one-half of the day is foggy in Vladivostok. Some years fog occurs almost daily; for instance in 1913 there were only twenty-two days free of fog during the above four months. In Okhotsk there are on an average twenty-six foggy days during the three summer months. On the western shore of Sakhalin Island there is little fog, but on the eastern shore of the island fogs are still more frequent and denser than on the Japan Sea coast. The scourge of southern seas, the typhoon, rarely visits the shores of the Soviet Far East.

In the central part of Kamchatka, which is divided from the sea by mountain ranges, the summer is comparatively warm and dry. Along the shores, especially the western, it is colder, with frequent fogs; the mouth of the Bolsheretsk has an average of sixty foggy days for the three summer months.

Further north, along the shore of the Bering Sea, the summer is colder; at Wellen the mean temperature of the warmest month is less than 6° C. The number of foggy days in the summer in this locality is twenty or less. As regards winds, although they are not as strong as in winter, they are nevertheless considerable; at Lavrentiya Bay in Wellen there are thirty days with blizzards out of the three summer months. Inland on the continent in the Chukhotsk-Anadyr district, the summer is considerably warmer than on the coast and the islands. At Markovo, in Anadyr, July has a mean temperature of over 14°, and the period when the average twenty-four-hour temperature is above 5° continues here for more than three months.

In those parts of the Far Eastern Territory where the monsoon character of the climate is rather marked, the tremendous difference between summer and winter is striking. In Vladivostok during the three winter months the sun gives 11.66 calories of heat for one sq. cm. of surface area, that is to say, more than anywhere else in the Soviet Union. During the three summer months the heat derived from the direct rays of the sun is 14.47 calories per sq. cm. less than at any other point of the U.S.S.R., and considerably less than the amount for the three spring or the three autumn months in Vladivostok itself.

TABLE 3. TOTAL HEAT FROM DIRECT SOLAR RADIATION
(in calories per sq. cm. of surface area)

Place	Winter XII-II	Spring III-V	Summer VI-VIII	Autumn IX-XI	Year
Yakutsk—62° 1′ N. Lat.	1.85	20.84	28.34	6.69	57.72
Irkutsk—52° 16′ N. Lat.	4.30	19.88	23.10	9.03	56.31
Feodosia—45° 2′ N. Lat.	2.64	19.04	39.10	14.16	74.94
Vladivostok—43° 7′ N. Lat.	11.66	18.76	14.47	15.39	60.28

The increase in the amount of the solar heat in winter and the decrease in summer are characteristic of the entire section of the territory where monsoons prevail. Although in clear weather the sun gives much heat in winter time, the loss of this heat through emanation increases. In the summer time the small amount of heat received directly from the sun's rays in a cloudy sky is supplemented partly by warmth from radiation from the arch of the sky and partly by warmth brought by the winds from a more southerly latitude.

In winter time the Far Eastern Territory has a polar climate, while in summer the southern part has an almost sub-tropical climate. From the table of temperatures it is evident that in the south of the continental part of the territory the coldest month of the year has a mean temperature of 20° above zero (Voroshilov, Khabarovsk, Blagoveshchensk); the average yearly range in temperature is over 40°. The least difference in winter and summer temperatures is on the southwestern shores of Kamchatka: the average yearly range of temperature at Petropavlovsk is approximately 21°, and on the islands in the Bering Sea only 14°. Throughout the remaining length of the Pacific coast of the Far Eastern Territory, the difference in temperatures between the warmest and coldest months of the year is more than 30°, but less than 40°.

Where the winter winds travel a certain distance over the open water before they reach the land they acquire water vapour and bring precipitation. In such localities precipitation falls more or less evenly throughout the entire year. Characteristic examples of such localities are Aleksandrovsk on Sakhalin, Petropavlovsk on Kamchatka, and Bering Island. All such localities are either on islands or peninsulas, separated from the mainland by bodies of water.

On the mainland under the conditions of a monsoon climate, the amount of the precipitation in summer is in sharp contrast with that in winter. Even on the sea coast, at Vladivostok, during the three winter months (from December through February) only 6 per cent of the yearly precipitation falls, while during the three warm months (July through September) 49 per cent falls. At Voroshilov and Khabarovsk the corresponding figures are 4 per cent and 54 to 57 per cent. At Blagoveshchensk from December through February only 3 per cent of the yearly amount of precipitation falls, and from June through August 64 per cent.

INFLUENCE OF TOPOGRAPHY

In the continental part of the territory, the character of the topography has a big influence on the climate, especially on the temperature. In winter the weather is clear twenty-four hours of the day, while in the warm half of the year the air directly above the earth's surface is heavily cooled at night and drifts to the lower parts of the area; therefore in such weather the higher places are warmer than the neighbouring valleys. In the basin of the Zeya River the range in average monthly winter temperature (in February) reaches 8°, and in individual places in the immediate proximity to the river it reaches 20°. In summer time the frost-free interval on the heights is longer than in the neighbouring valleys. This difference amounts to approximately fifty days.

The flow of the rivers corresponds to the main features of the climate. In the typically monsoon parts of the territory where winter precipitation and the snow cover are very small, spring floods are usually absent or expressed in a very slight increase in the volume of water. As against this, big rises in the river levels take place in the period of the greatest summer precipitation. In the parts of the territory under consideration, heavy rains of a torrential character are not infrequent, giving a rainfall of 100 mm. in twenty-four hours or more. In the Vladivostok district, maximum twenty-four-hour precipitations of over 200 mm. have been observed; the largest occurred in Suchan in June, 1929. If heavy rains fall simultaneously over a considerable area included in the basin of some single river, the rise in water attains the proportion of a destructive flood. In those districts of the territory where there is heavy precipitation in winter and a deep snow cover, as in Kamchatka, for example, the greatest water-flow occurs in spring time.

PERPETUAL GROUND FROST

The perpetual ground frosts consist of a layer of ground which does not thaw out in summer and remains frozen throughout a long period of years. The question of the time when perpetual ground frost sets in has not yet been solved. It is only certain that contemporary climate conditions are such as to preserve it in all those cases where the upper layer of soil which thaws in summer is again completely frozen during the following winter, and the temperature of the perpetual frost is not raised from year to year. Sometimes between the lower level of winter frost and the upper level of the perpetual frost, a layer of unfrozen ground of varying thickness intervenes. The presence of such a layer indicates a change of external conditions in directions unfavourable to the preservation of the ground frost. A large part of Kamchatka is free from perpetual ground frost, the limit of which crosses Kamchatka in the northern part. The distribution of perpetual ground frost within the outer limit is not uniform. In the southern part of the area, perpetual ground frost is encountered only in patches, where there are valleys with a peat-moss covering, or on northerly slopes. Further north, and in the northwest, the perpetual ground frost begins to predominate, surrounding isolated patches of thawed ground; further on it becomes more or less uniform. The thickness of the layer of the perpetual frost varies from a few cm. at its southern limit to many tens of meters. The depth of the thawing of the top soil in regions of perpetual frost varies greatly: from twenty to forty cms., under heavy moss covering, to three m. in dry sandy soils.

The winter cold under conditions of the ordinary snowfall is sufficient to preserve the perpetual frost over a considerable part of the Far Eastern Territory—but only in the presence of a heavy peat-moss and turf covering, which greatly hinders the penetration of warmth into the soil in summer time. Therefore, in many places, especially near the southern limit, the upper level of ground frost rapidly recedes until it finally disappears completely if the organic cover on the soil is either destroyed or mineralized (by burning, ploughing, etc.).

Soils which are perpetually frozen, and cold unploughed soils in general, have very little surface evaporation. The occurrence of precipitation mainly in the course of the brief summer period leads to a widespread excess of moisture in the soil. Excess of moisture, however, disappears without a trace when the temperature of the soil is raised.

Perpetual ground frost in itself is not an obstacle to the development of agriculture, since the temperature of the upper layer of ploughed land is sufficiently high in summer. In addition, special methods of heat amelioration may be used. Construction on perpetually frozen ground encounters greater difficulty. In recent years, however, a number of methods have been worked out for eliminating the harmful influence of perpetual frost on road, house, and other forms of construction.

The perpetual frost is almost impenetrable to water. Results of this circumstance are, on the one hand, the frequency of surface swamps and, on the other hand, the absence of underground water or the great depth at which it occurs. In autumn and winter, when the surface soil freezes, all flow of surface water stops; but on the slopes water continues to flow in the unfrozen layer of soil between the upper level of the perpetual frost and the lower level of the winter frost, provided this layer is sufficiently porous. If anywhere along the course of the water freezing proceeds more rapidly, the winter frost merges with the perpetual frost and forms a barrier to a further flow of the water. However, in the area above the solidly frozen area, the flow of the water continues. The increasing hydrostatic pressure causes cracks to form in the soil through which the water comes to the surface and forms an ice field which gradually increases through new accretions of water. These ice fields also form on the surface of the normal ice crust of rivers, if at some point the water in the rocky river bed freezes solid.

The formation of these ice fields often precedes considerable uplifts of the soil on the ice, forming ridges or mounds. As a result of internal pressure, the ice-field ridges frequently burst with great force. At such times huge fragments of ice are flung a considerable distance, and water gushes through the opening. If a tree happens to grow where the crack forms it may be split lengthwise. Ice fields are formed in those continental parts of the territory where winter temperatures are low and the snowfall sparse.

Road surfaces at a foot of a slope facilitate rapid freezing of the soil. As a result, in the presence of flowing underground water, ice fields are formed, making the road impassable. By forming so-called "frost belts" the soil on the slope above the road is frozen, causing an artificial ice field to form at that point. The formation of ice fields further up the slope protects the road surface from damage.

IV

INLAND WATERS

THE RIVER SYSTEMS

THE FAR EASTERN TERRITORY is extremely well irrigated. Many large rivers flow through its vast area, with ramified systems of tributaries. The rivers of the territory flow to the basins of two oceans: the Pacific (the Okhotsk, Japan and Bering Seas) and the Arctic.

The extremely rugged topography, perpetual ground frost impenetrable to water, the torrential summer rains, and the general heavy precipitation in the territory lead to an extremely rapid surface flow of water, very little seepage, and the formation of large river systems throughout the area. This explains the main peculiarity of the rivers of the Soviet Far East: the tremendous range of variation in the water level and the low water level in winter.

All the river systems of the Far Eastern Territory rise in the mountain ranges and their spurs. The mountains play the main part in gathering the water, for the moist sea winds, blowing from the Southeast, in their course across the mainland encounter cool elevations, which draw from them the main store of moisture. Many of the rivers in the territory derive their water from rains (all rivers of the Amur basin and the coast of the Japan Sea). A considerable part of these rivers (those of the southeastern Maritime District) also are fed only by rains. Those rivers which are mainly fed by rains are characterized by flood waters in summer and by one or two high-water periods in spring, with sharp rises. (When two rises occur, the second is usually the result of the joint action of melting snow in the mountains and of summer rains.)

A few of the rivers in the territory receive their water from melting snow and ice in the mountains (the rivers of the Okhotsk shore and Kamchatka), and a very few rivers from the melting of snow on level areas (Chukotka).

The slopes of river valleys in the territory have all the typical features of mountain rivers, as a result of the geological youth and immaturity of the streams.

The Amur is the main river of the Far East of the U.S.S.R. It is formed by the confluence of the Shilka and Argun rivers. The Amur includes almost the entire area of the territory in its basin and has a length of 2,876 kms. within the territory. In its upper reaches the Amur is a mountain river; it flows through mountainous regions and has rocky banks. Rapids and sharp turns are frequently to be encountered along its course. Beginning at the junction of the river Zeya, the Amur flows through even ground and is quiet in character. Lower down where the river encounters the Lesser Khingan it again acquires a mountain appearance and later again becomes a smooth-flowing river and continues such to its mouth. The Amur flows into the Amur Inlet of the Tartar Sound. It has a number of large tributaries all along its course. The principal ones are the following: on the left bank, the Zeya (1,376 kms.), the Bureya (1,664 kms.), Bira (278 kms.), Tunguska (484 kms.), Gorun, Amgun (906 kms.); on the right, the Sungari (1,866 kms., which runs entirely through Northern Manchuria), the Ussuri (938 kms.), and its main tributary the Sungacha—a river flowing out of Lake Khanka.

The Amur River is navigable below the junction of the Zeya River. Among the tributaries of the Amur, the following are navigable: the Zeya and its tributary the Selemdzha, the Bureya, the Tunguska, the Bira and Ussuri (for a distance of 640 kms.). In addition to navigation, the Amur basin is used also for log-floating. The logging length of the Amur is 50 per cent greater than its navigable length.

South of the mouth of the Amur, the Khodi, Kopi, Samargi, Kusin, Amgu, Tiutikha rivers, and others, flow into the Japan Sea. None of them are navigable, and they can only be used for floating logs. North of the Amur, the Uda, Tugur and Okhota rivers fall into the Okhotsk Sea; they also are not navigable.

Of the territory's remaining rivers the following deserve mention: the Penzhina and Kamchatka on Kamchatka Peninsula, the Anadyr, Omolon and Anzhui on Chukotka, the Kolyma in the Okhotsk district, and the Tym on Sakhalin Island. These rivers are navigable and good for floating logs, but actually there is no navigation on most of them.

As was indicated above, summer and early autumn in the territory are accompanied by heavy and prolonged torrential rains, which sometimes fall over a wide area. These torrential rains cause floods. Floods are further facilitated by the orographical conditions of the territory, the crystalline rock formations that ridge the country, by perpetual ground frost, as well as by the peculiar distribution of the tributaries and the many rivers as a result of which large volumes of water reach the main stream simultaneously. Devastating and destructive floods are extremely frequent in the territory. Thus in the period from 1861 to 1931, that is, over a period of seventy-one years, strong floods were recorded in thirty-three years; in eight years these were exceptionally severe (in 1872 the Amur, Shilka and Argun; in 1877 the Iman and Ussuri; in 1896 the Suifun; in 1908 the Maritime district; in 1914 the Amur; in 1924 the Selemdzha; in 1928 the Zeya and Amur). Floods usually occur in July and August and most frequently in the basin of the Ussuri River and the southern part of the Maritime district, that is, in the southern parts of the territory. No rules or sequences have been ascertained as regarding the occurence of floods from year to year. They are episodic like their torrential character. In lowland districts they are less sudden but more prolonged. The control of floods is one of the territory's main problems; and in this connection certain successes have already been registered along the line of moving structures to safer places and regulating the rivers.

The many rivers of the territory, the mountainous character of many of them, and the large flow of water create favourable conditions for power generation. The total reserve of water power in the region has been calculated by the Far Eastern Institute of Geo-Physics at 62 million h. p., or about one-fourth of the total water-power resources of the U.S.S.R. The total power of hydro-electric enterprises that are technically capable of realisation amounts to 5 million h. p.

The exploitation of the water resources of the Far Eastern Territory must be many-sided. Besides supplying water power it must help to improve navigation, log floating, and flood control.

LAKES

The Far Eastern Territory abounds in lakes, some of them very large. The principal ones are Khanka (area 4,300 sq. kms.) Bolon (1,100 sq. kms.), Chukchagirskoe (740 sq. kms.), Evoron, Kizi, Udil, Oryo, Kronotskoe. In addition, there are small lakes near the river mouths. In the southernmost part of the territory, at the mouth of the river Tumen-Ula in the Poset district, is Lake Talmy, which is used for salt distilling.

V

THE SOILS

THE SOILS of the Far Eastern Territory are very diverse. This diversity is bound up with the differences in the factors of soil formation in the district (climate, vegetation, continental soil-forming deposits, etc.).

THE TUNDRA

Through the northernmost section of the Far Eastern Territory extends a picturesque region of tundra and wooded tundra (the Chukotsk and Koryak national regions). Almost all of this region lies within the line of perpetually frozen sub-soil. Because of the existence of this layer of frozen soil, which hinders vertical drainage, and of the low temperatures and scanty evaporation, the tundra soil is very wet. Also, the sandy, dusty argillaceous soil of the tundras easily takes on the consistency of quicksand. The motion of quicksand-like masses downhill under the influence of the gravitational forces of the soil seams, causes a deformation of the soil seams, leading to the formation of peculiar spots, mounds, etc., on which nothing grows. This peculiar spotted and knolled profile of the tundra soil is found also on the flat watershed sections of the argillaceous soils. But the origin of the spots and mounds, which is bound up with the phenomenon of the freezing of damp soil seams, is much more complex in conditions of perpetual frost. All these deformations of the sub-soil are of great importance in construction work in the zone of perpetual frost.

The great over-saturation of the masses of the tundra soil, which can be observed even on well-drained slopes, causes the widespread development of gleet and swamp processes.

The zonal type of the tundra soils is the specific gleet soils. There is also, in the well-drained spots, a weak development of podsolic soils which, however, show clear signs of becoming swampy very near to the surface. The tundra soils are for the most part poor in elements of nutrition and show little microbiological activity. It is nevertheless quite possible, as has been shown, to use them for agricultural purposes.

The facts available show that it is possible by methods of agricultural technique not only to hold in check the unfavourable characteristics of the tundra soil, but even to transform these soils. Aside from drainage and the possible improvement of temperature conditions (connected with artificial conditioning), the tundra soils demand the introduction of fertilizers and a radical improvement in microbiological activity. The improvement of microbiological processes is attained by the introduction of thoroughly decayed manure. The best results are achieved by the combination of prepared manure with mineral fertilizers in forms suitable for vegetation.

THE TAIGA

To the south, the tundra and wooded tundra border on the vast Okhotsk taiga (forest) region. This wooded region is, for the most part, a region of perpetual frost, with islands of thawed soil. The depth of the active layer here is considerably greater than in the tundra. The layer of perpetual frost lies as low as two or four metres below the surface in drained soils. It is only in the peat bogs that the thickness of the active layer seldom exceeds from forty to fifty cm. Almost all the taiga soils are to some extent gleet soils at the surface. This gleet may be temporary, coinciding with the periods of extreme dampness of the surface of the soil, or may become permanent. One can, nevertheless, divide the soils of the Okhotsk taiga zone into two broad categories: soils of the alluvial series, i.e., soils in which washing-on processes are going on, and where solutions circulate vertically from the upper horizons of the soils to the lower; and soils of the swamp series, in which there is a lack of oxygen during these processes, and the vertical circulation becomes lateral, or even reverses—from the lower seams of the soil to the upper ones.

ALLUVIAL SOILS

Of the soils of the alluvial series, we must note first of all the wooded brown soils (or disguised podsolic soils). These soils, which extend over considerable areas, have no morphologically expressed podsol character. The wooded brown soils of the Far Eastern Territory are little known. They are very weathered, but scantily lixiviated. The regions of their development follow the shore lines, where the climate is damp and warm. The monsoon character of the climate of the Far Eastern Territory is, probably, one of the main factors in the formation of the brown soils. The podsolic soils are considerably more widespread. There are soils in all stages of podsolization, from barely podsolic soils to very podsolic ones.

SWAMP

Among the soils of the swamp series, we should note a special group of soils—the so-called knolled mareys (swamps). This group of soils is a complex of peaty, gleety clay soils, located in the depressions of the profile, and gleety clay soils in the knolls (the knolls are one metre and over in height, 150 to 170 cm. in length, and 100 to 130 cm. in width). The formation of knolls is bound up with the phenomenon of the bunching of clayey soils on freezing in conditions of permanent frost.

DISTRIBUTION

We shall give a brief characterization of the indicated soil differences in the region of the Okhotsk taiga. (See p. 50).

In connection with the geo-morphology of a country where considerable areas are occupied by mountain systems, there is a great development of roughly built stony soils, so that considerable areas are taken up by stony, non-plowable soils on sandy and clayey alluvium. The more dispersed and thin alluvia of argillaceous clay and sandy, clayey soil are found not only at the surfaces of the vast plateaus but also at large ancient lake and lake-river basins (the Upper Zeya basin, the Zeya-Selemdzhino-Bureya basin, the Amur basin, and others). But processes of swamp formation are widely developed in these basins, and the large masses of soil need reclamation by drainage.

SOIL IMPROVEMENT

The development of agriculture in the Far Eastern Territory demands the mastery of the virgin taiga lands. Despite their diverse composition, the virgin soils of the alluvial series (brown soils and podsolic soils) have a small supply of nutritious elements suitable for vegetation. Due to a certain surface marshiness and scanty microbiological processes, the taiga soil usually gives no harvest the first year. In the second year there is a great increase in the yield. But these necessary elements are quickly expended by the soil, and after one or two years its fertility decreases. The introduction of manure fertilization greatly increases the yield. The best results are obtained by the use of manure together with mineral fertilizers.

The group of swampy soils sometimes have reserves of food elements, accumulated over very long periods. The peaty, gleety and argillaceous soils and sedge swamps (mareys) are especially rich. But, of course, these soils need draining.

The interesting experiments of the Ogoronsk station show that the frost in the soils of the swamp series is very shallow and does not hinder their exploitation. After seven years of cultivation, the frost level of the peat-gleet soils of the Ogoronsk experimental station was lowered from 40 cm. to 170 cm. During the first two years of cultivation on peat-gleet soils, agricultural vegetation sometimes gives no harvest (despite the draining of the soil). But from the third year on, the yield grows unfailingly and reaches satisfactory figures. The Ogoronsk station obtained the following harvests in 1932, in the sixth year of cultivation of the frost swamp, without fertilization:

	(In centners per hectare)
Summer wheat	14
Summer rye	18.5
Oats	27.5

Thus, there are promising prospects for the cultivation of the soils of the swamp series.

We shall now consider the southern, southeastern, and partly the eastern (Kamchatka) sections of the Far Eastern Territory. These regions lie in part beyond the line of perpetual frost (southern and central Kamchatka and the coastal section) and in part in the regions of islands of perpetual frost amid thawed soil. The factors of soil formation here are very different. This is the region of the peculiar Manchurian taiga; here there is a great intensification of the monsoon element in the climate. Kamchatka stands out as a separate district, characterized by the flora of its grassy (herbaceous) sparse coast woods and the specific character of the soil-forming layers, bound up with volcanic mountain layers.

In the Maritime district there is undoubtedly taking place an intensification of the southern elements of soil formation; and wooded brown soils are becoming widespread, side by side with the podsolic and swampy soils. In many cases there have been found red kaolin products of weathering. But the period of their formation is not known.

In Kamchatka the prevailing soil types are the peculiar grassy meadow soils and the meadow, or scantily podsolic soils. In these soils the process of podsolification has been balanced by a huge secondary accumulation of humus and of a number of elements of meadow vegetation. These soils usually have large reserves of elements necessary for the life of the vegetation. In the Kamchatka valley (the Central Kamchatka Depression), in the Milkovo region, these soils give splendid harvests without fertilization (up to twenty-three tons of potatoes per hectare). These nutritious elements, however, are in very mobile combinations; and after a few years of cultivation these soils will undoubtedly need fertilization. The grassy meadow soils of the western coast of Kamchatka are a little poorer, due to differences in the composition of the soil-forming layers; but the basic reason of their low productivity lies in the suppression of microbiological activity (as a consequence of the unfavourable climatic conditions of the eastern coast).

True podsolic soils in Kamchatka have developed only under the coniferous forests in the region of the so-called coniferous island of Kamchatka (the region of the Central Kamchatka Depression).

VI

VEGETATION

THE FAR EASTERN TERRITORY is exceptionally interesting in regard to vegetation. No other region of the U.S.S.R., except perhaps the Caucasus and the Crimea, can compete with this district in variety of flora. We encounter here forms of vegetation remaining from the pre-glacial period, which have long since disappeared in almost all parts of the northern hemisphere.

The southern part of the territory gives us an exceptionally interesting picture of the mass acclimatization of southern Tertiary forms of vegetation and their gradual adaptation to a cooling climate. One can see in this district the rarest combinations of induvial forms of vegetation, with exceptional resistance to low temperatures. In the huge expanses of the district we find, on the one hand, flora of the zone of broad-leafed forests and, on the other hand, almost entirely treeless tundra. The exceptional variety of the vegetation of the Far Eastern Territory is due, mainly, to the climatic, soil, and orographic differences between various sections of the district.

EFFECT OF CLIMATE

The most important factor acting on the vegetation is, doubtless, the climate. In the south, where the period of vegetation lasts 5 or 6 months, the vegetation is very luxuriant, including even Tertiary forms (nut, velvet cork tree, lotus, etc.). In the extreme north, on the other hand, where the period of vegetation is very short (2 to 2½ months), there have developed entirely different forms, adapted to this short period. There are almost no trees here; they are replaced by bushes and arctic grasses.

No less important a factor are the soil conditions. Where the soil is rich and deep there develop splendid meadows and luxuriant mixed leafy and coniferous forests. Where the soil is shallow and stony, we find at best forest vegetation (e.g. fir and larch forests); but in most cases these soils give shelter only to a very scanty grassy coating or to mosses and lichens (in the north).

The perpetual frost, widespread in the northern part of the district, also has a great influence on the vegetation. In the regions of perpetual frost we find none of the heat-loving trees, no luxuriant meadows.

EFFECT OF TOPOGRAPHY

The profile of the district has a great influence on the distribution of the vegetation. At the highest points, where we observe the upper limit to the development of forest growths (900 to 1,000 and more metres above sea level), we find unwooded areas, "naked surface spots" as they are called; below them on the slope there are usually forests (fir, larch, cedar, etc.); and in the lower parts, where the slope is not so steep, there develop the most diverse types of vegetation—rich forests and luxuriant meadows. In the extreme north the mountain ridges are covered mainly with mosses and lichens, while trees and grassy flora usually gravitate to the river valleys and the lower parts of the mountain slopes.

REGIONAL DIFFERENCES

The vegetation of the Far Eastern Territory is not as yet sufficiently known. We have, for instance, only scanty data brought back by expeditions on the regions that lie to the north of the Shantarskie Islands.

In the central and southern parts of the Far Eastern Territory we usually distinguish three floristic sections: the Manchurian (Ussurisk), the Okhotsk, and the East Siberian regions. Each of these regions has certain distinguishing features and a specific composition of its vegetation. We shall limit our characterization of the vegetation of the district to the above-mentioned floristic regions, as their flora are the best known, and it is easiest to link up the description of the main types of vegetation with them.

THE MANCHURIAN REGION

The richest in the composition of its vegetation is the Manchurian region (Ussurisk). The Manchurian floristic region lies within the following boundaries: to the east, at Blagoveshchensk, its boundary lies along the left side of the Amur River valley, jutting out on the large tributaries on the left side of the Amur: the Selemdzha, the Bureya, the Arkhara, the Tunguska, the Gorin; at Komsomolsk the boundary crosses to the right bank of the Amur, then turns sharply to the south and winds along the western spurs of the Sikhota-Alin range to Vladivostok, around which it bends in the Suchan region; further on the boundary follows the eastern spurs to Samarga Bay (47° north latitude), on the coast of the Gulf of Tartary, where it descends to the sea. The western and southern boundaries of the Manchurian floristic region go beyond the boundaries of the U.S.S.R., into Manchuria and North China.

The section covered by the Manchurian floristic region is characterized in general by a damp sea climate and shallow snow, with an average yearly temperature of +5° to —0.4° C. The soil of the region is very diverse. There are all sorts of soils, from barely podsolic skeleton soils on the rises and heavy argillaceous podsolic soils on the slopes to alluvial soils in the valleys and peat bogs in the lower parts of the region.

The vegetation of the Manchurian floristic region is mainly forest flora. The most thickly wooded regions are: the basin of the Upper Zeya; the Bureya highlands, and the region of the Sikhota-Alin range, including the upper part of the Ussuri and the basins of the Iman, the Bikin, and the Khor; and the sea coast up to Ternei Bay. There is less forest in the Prikhanka lowland and in the Ussuri valley (about 30 per cent of the region).

The forests of the Manchurian region are made up of Korean pine (*Pinus koraiensis*), whole-leafed fir (*Abies nolophylla*) in the southern part of the district, spruce (*Picea obovata*) in the mountains and narrow valleys, Ayan fir (*Picea ayanensus*), oak (*Quercus mongolica*), ash (*Fraxinus manchurica*), walnut (*Juglans manchurica*), the velvet cork (*Phellodendron amurense*), maple (*Acer manchuricum*), lime (*Tilia amurensis*), and many other trees.

Among the most important bushes we note: hazel (*Corylus heterophylla* Mansh.), high cranberry (*Viburnum sargentii*), mock-orange (*Philadelphus tenuifolius*), bush-clover (*Lespe-*

deza striata), lilac (*Syringa amurensis*), honeysuckle (*Lonicera Maackii,* Masimovoszii).

Through the forests wind liani. Of these, we must note: grape (*Vitis amurensis*), *Schizandra chinensis,* currant (*Actinidia argute* A. Colomieda). The grassy flora is numerous and luxuriant. The most important of the plants are: bracken in the river valleys and damp spots, ostrich fern (*Struthiopteris*), cinnamon fern (*Osmunda cinnamomea*), *Pteridium agrulinuna,* male fern (*Dryopteris filix,* Mas.), maiden-hair fern (*Adianthum pedatum*). Cereals: *Langsdorffia,* in the meadows bunker-grass (*Spodiopogon sibiricum*), eulalia (*Miscanthus sachariflories*). Among the various grasses there are many fodder and medicinal plants.

There are in all, according to Academician V. L. Komarov, 1,966 species of flora in the Manchurian region; of these, there are about 80 sorts of trees.

Along the slopes and spurs of the mountain ranges in this region we find in the forest group: Korean pine, Manchurian fir, oak, Ayan fir, and lime. In the underbrush: Manchurian hazel nut, jasmine, and maple. In the grassy carpet, besides various sorts of bracken, we find forest sedge (*Carex sinderosticta.*)

In the river valleys, the cedar and broad-leafed forests are joined by certain Okhotsk coniferous varieties: Ayan fir (*Picea ayanensus*), white fir (*Abies nephrolepis*); these crowd out the light-loving leafy trees.

In the very damp valleys of the drained slopes there develop forests made up of Manchurian ash (*Fraxinus manchurica*), elm (*Ulmus japonica*), velvet cork (*Phellodendron amurense*).

In the undergrowth we find: *Sorbaria sorbifolia* and high cranberry (*Viburnum sargentii*).

The mixed cedar and broad-leafed forests, thinned by chopping and forest fires, are apt to become more purely broad-leafed forests, where leafy trees predominate: maple, oak, lime, birch. In the underbrush, hazel and high cranberry predominate. To the grassy carpet are added *patrinia,* aster, and feather grass.

As to oak forests, the following are frequently met in the district: oak forests with bush-clover (*Lespedeza striata*), and oak forests with Japan hazel (*Corylus heterophylla*). The former grow on the large mountain slopes with rubble and stony soils. The latter grow on slopes which are not steep and on flat watersheds. The ridges of the mountains are covered with oak forests, and among them meadows covered by xerophyte grasses. Among the single bushes are: Siberian rhododendron (*Rhododendron dahuricum*) and bush-clover; among the grasses we find wormwood (*Artemisia keiskeana*), meadow grass (*Poa sp. Atractylodes ovata*), cow-wheat (*Melampyrum roseum*), and others. Along the ridges in the southwestern part of the coast region we often meet groves of mourning pine (*Pinus funebris*), with hazel bushes in the underbrush.

The vegetation includes very many different trees and bushes. Among the elms (*Ulmus japonica*), velvet cork (*Phellodendron amurense*), ash (*Fraxinus manchurica*), and walnut (*Juglans manchurica*), there has developed a rather thick undergrowth of high cranberry and honeysuckle.

There is almost no high mountain belt of vegetation in the Manchurian floristic region, unless we consider the peculiar growth of coniferous bushes—the "microbioti" (*Microbiota decussata*) that covers the open slopes of the heights in the southern Maritime District. These microbiotic growths are not strictly *gol'tsov,* but separate genuine *gol'tsov* plants grow among them, giving these growths the appearance of *gol'tsov* vegetation. The origin and development of these growths, however, is quite specific, and they have little in common with the real *gol'tsov* groups.

THE OKHOTSK REGION

The second floristic region of the Far Eastern Territory—the Okhotsk region—is characterized mainly by mountainous landscape, with narrow river valleys, thin mountain, poor argillaceous and disguisedly and scantily podsolic soils, and a damp, severe climate.

The Okhotsk floristic region does not constitute any single closed region of the Far Eastern Territory, as does, for instance, the Manchurian region. According to the latest information, it is made up of a series of large, unconnected areas whose location is determined by the largest ridges of the mountains: the Sikhota-Alin, Lesser Khingan, and Bureya ranges.

The geographical boundaries of the Okhotsk floristic region of the Far Eastern Territory are: at the south, the southern extremity of the Sikhota-Alin range at Suchan; the lower boundary is about 600-650 metres above sea level, at Samarga Bay (48° north latitude, on the coast of the Japan Sea), where it descends to the shore. A separate fragment to the south is a section in the Poset region on the Soviet-Korean-Manchurian border, on the Tio-Tze-Shan range. The eastern boundary seems to be marked by Sakhalin; but we must assume that the region includes the Kurile Islands. The Okhotsk floristic region within the Far Eastern Territory is limited on the west mainly by the spurs of the lesser Khingan, the Bureya range, the Tukuringa, and certain others. The northern boundary is not exactly known, but many facts indicate that it lies along the Stanovoi range, coming out on the shore of the Sea of Okhotsk at Ayan (56° north latitude). The largest northern fragment of the region is on Kamchatka Peninsula in the valley of the Kamchatka River near Klyuchi and Kozyrevskaya. Beyond the boundaries of the Far Eastern Territory we know of the following spots of the Okhotsk floristic region: in Manchuria in the mountains of the Lesser Khingan and the Peishan mountains; in northern Korea; in northern Japan (the islands Yezo, Hondo, Hokkaido, and Japanese Sakhalin).

The vegetation of the Okhotsk region is exclusively forest. Most of the forests in this region are one-tiered. The predominating species are: Ayan fir (*Picea ayanensis*), white fir (*Abies nephrolepis*) and Sakhalin spruce (*Abies sakhalinensis*) on Sakhalin Island; larch (*Larix datrurica*), stone birch (*Betula ermani*), flat-leafed birch (*Betula platyphylla*), Maximovich poplar (*Populus maximovichii*), and various arborescent osiers in the river valleys. Characteristic bushes are: yellow maple (*Acer unurunduense*), rowan tree with elder-type leaves (*Sorbus sambucifolia*), Middendorf birch (*Betula middendorffii*), and wood sorrel. Grasses are comparatively well represented in variety; but in quantity they are much less than in the Manchurian region.

The characteristic carpet in this region is made up of mosses and lichens. Green mosses cover the surface of the soil in a solid layer over which is scattered in various places the above-mentioned flora. There are not more than 850 or 900 forms of plant life in the Okhotsk region.

The most frequent forest groupings in the Okhotsk zone are the fir and spruce forests spread over the mountain slopes of the Sikhota-Alin range. These forests are made up mainly of Ayan fir and white fir. At 500 or 600 metres above sea level, they are joined by stone birch; in the river valleys, by larch. In the sub-*gol'tsov* strip at the height of 700 to 800 metres we find scatered groups made up only of stone birch (*Betula ermani*). In the undergrowth, amidst the low, crooked trunks of the birch, we find mountain pine (*Pinus pumilio*), golden rhododendron (*Rhododendron chrysanthum*) descending from the *gol'tsov* and the creeping swamp plant (*Ledum recumbens*), as well as a thin grassy carpet. The groups of stone birch are usually the last signs of forest vegetation; beyond these begins the belt of sub-*gol'tsov* and *gol'tsov* vegetation. In the belt a prominent place is occupied by mountain pine (*Pinus pumilio*), which sometimes forms almost impassable growths. Among the grasses we find several high mountain *gol'tsov* growths, with here and there mosses and lichens. Still higher, these groups give way to open places, covered only with a solid carpet of moss and lichens, or separate spots among the scatterings which usually crown the *gol'tsov* peaks.

Leafy groupings are found at almost all levels (from the lowlands to the peaks) ; in some cases these groups have various undergrowth and grasses.

The fires that pass through the leafy forests not only destroy the trees and grasses and the upper layers of the soil, but at the same time promote the development in their place of white birch forests (*Betula manchurica*), in the south and in the north.

The swamp vegetation of the Okhotsk region on the banks of the rivers is made up either of clusters of arborescent osiers or of poplars. In the undergrowth of the forest growing on very damp places we usually find alders and eglantine.

The shallows of the river banks are taken up by bushy osier beds (*Salix viminalis*), bordered by a butter-bur (*Petasites palmata*) and other growths which can stand dry periods. In view of the very uneven profile of the locality of the Okhotsk floristic region, the importance of the vegetation along the water space becomes very great and definitely influences the regime of the rivers.

As a result either of forest fires in the mountains, which destroy hundreds of square kilometres of forest, or simply of thoughtless chopping, there are considerable rises in the level of the water after there has been much rain—usually in the summer months—which cause floods, and often do enormous damage, sweeping away, for instance, not only the vegetation immediately surrounding the river but the entire soil coating of the mountain slopes and the river valleys, leaving often huge areas of pebble alluvia and scattered stones. It is therefore essential to preserve the vegetation around the rivers and at the same time to make correct use of the mountain forests.

It has been noted that erosive processes in the Sikhota-Alin range and in other places, caused by the reasons mentioned, are very widespread of late. Hence the use of the vegetation of the valleys must be subjected to special rules.

In Sakhalin we meet fir and spruce forests which differ from the continental forests by the presence in the second tier of Sakhalin spruce (*Abies sakhalinensis*), which takes the place of the white fir.

THE NORTH

Beyond the northern boundary of the Okhotsk floristic region the main vegetation consists of larch forests, made up of Daur larches, which are widely spread throughout Siberia and the Far East.

The entire vegetation of these regions differs radically from those of the Manchurian and Okhotsk regions; in composition and development it can be attributed to the so-called East Siberian floristic region, which extends far to the north and the west within the Yakut A.S.S.R., and includes the entire northwestern section of the Far Eastern Territory.

Up in the mountains the larch forests decrease, giving way either to a growth of mountain pine with a lichen carpet or to solid spots of fir groves and semi-arctic bushes. Vegetation in damp spots along the rivers made up of poplars, arborescent osiers, and Coyander birches settle on the alluvia in the river valleys. The groups of such vegetation grow sporadically and stand out from the other types by their external appearance and the variety of their composition.

On the slopes at the sea coast or in the higher belt among the rocks grow clusters of stone birch; these are wide-spread in Sakhalin, Kamchatka, and on the Okhotsk coast.

As we approach the Penzhinskaya and Gizhiginskaya Bays, the larch woods become thinner, and the character of the vegetation approaches that of the wooded tundra. Here we still notice the influence of the Daur larches and bushes, which penetrate into the regions along the mountain slopes and river valleys. The lower regions are covered with huge osier beds, which form a bushy tundra. Bushy birches and certain osiers are the main types; among them we find at first fragments, then whole areas of lichen and moss tundras.

The lichen and moss tundras at the very edge of the continent quickly disappear and are replaced entirely by Arctic tundras, where there is not even a hint of any sort of bushes, and there are more lowland swamps and lakes, with their characteristic vegetation.

FOREST COMPOSITION

It is evident from this characterization that the Far Eastern Territory is mainly a forest country. The composition of the forests of the Far Eastern Territory is extremely diverse; there are about 85 types of trees in the region. Of the eight billion cubic metres of wood reserves of the Far Eastern Territory, 2.5 billion are larch, 2.5 billion fir, one billion spruce, one billion cedar, 0.8 billion pine, 0.4 billion birch, and 0.2 billion oak. There are among these many very valuable types of wood.

The Ayan fir and the white fir are most valuable raw material for the cellulose and wood-working industries. The Korean pine —the main type of the Far Eastern forests—gives splendid building material, and bears large cones and nuts. The mountain pine which is widespread in the northern part of the territory also bears excellent nuts. The woods of the Mongolian oak, ash, lime, elm, velvet cork tree, nut, and birch are used in the most expensive and delicate branches of the wood-working industry and in airplane building. The iron birch, which grows in the southern part of the territory (in the Poset region), can be used in place of imported wood for special wooden parts in machine building.

Manchurian walnut, like other hard leafy types, gives excellent material for the preparation of airplane parts. The *Akatnik,* with its brown wood, has a very strong resistance to decay. The velvet cork tree (the Amur cork tree) has a trunk covered with a growth of cork about 3 or 4 cm. thick; this cork is used in thermotechnics. The Mongolian oak gives "Spiegel" boards, a splendid decorative material (for walls, etc.). The Manchurian ash gives the best raw material for plywood production; the nails used in building boats are made of white lilac or of maple. The Far Eastern Territory thus yields very valuable woods for building and for various manufactures.

We must note also the presence of very fine honeybearers in the Far Eastern forests: maple, the velvet cork tree, the Manchurian walnut, honeysuckle, bush-clover, etc. Far Eastern honey, along with Mexican honey, is the best in the world, and has already been recognized as such on the world market.

FRUITS AND BERRIES

The Far Eastern woods are very rich in fruits and berries, including apples, pears, blueberries, ashberries, honeysuckle, hawthorn, hazel-nuts, Amur grapes, cranberries, currants, cloudberries, and raspberries. The Amur grapes contain juice of exceptional color, which used to be exported to France to give a better taste to wines, but is now mainly used by the local population for the preparation of wine. The currant (*Ribes actinidia*) gives a yellow wine, somewhat like champagne in taste. A large vine of the Amur grape or currant yields up to one pail of berries. All the fruits of the Far Eastern Territory are to an exceptional degree used to low temperatures and can be utilised for the introduction of fruits into colder countries. Certain famous types of fruit were developed by Michurin on the basis of his study of certain Far Eastern varieties. In the southern parts of the territory alone there are up to fifty types of wild berries and fruits.

MEDICINAL PLANTS

Various medicinal plants, used since ancient times in China and Mongolia, grow plentifully in the forests of the Far Eastern

Territory. The most interesting of these are: ginseng (*Panax ginseng*), Chinese clove, valerian, lycopod, and the sacred lotus (on Khanka Lake). Ginseng is a grass of the *araliaceous* family. In the Ussuri region grows wild ginseng of the best quality in the world. The roots of the ginseng are very highly valued. All the medicinal plants of the Far Eastern Territory are used in the U.S.S.R. and exported. Among the flora of the Far Eastern Territory there are a number of plants that can be used as tannin (the bark of the larch and the oak, the root of *badan*) as essential oil-bearing plants (marsh rosemary, lilac, iriganum); as dyes (the cork of the velvet cork tree, the bark of the alder, and the buck thorn); and finally as fibrous substances (nettle, lime).

DECORATIVE PLANTS

The Far Eastern forests possess a number of plants exceptionally suitable for decorative purposes—maple (*Acer pseudo-sieboldii*) has a very rich handsome foliage and is a splendid park plant. The bushes which blossom so beautifully in the fields and meadows—jasmine, guelder-rose, honeysuckle, lilac, white and purple roses, red lilies, the Sakhalin cherry, rhododendrons, irises, peonies—lend a special beauty to the Far Eastern landscape.

Finally, the tundra, the swamps, and the meadows of the territory provide fodder for cattle and ensure a good and plentiful crop of hay.

VII
FAUNA

STRETCHING from the vast Arctic to the warm southern seas, with its varied topography and vegetation, the Far Eastern Territory could not fail to have a diversified fauna. Its denizens include typical polar species: polar bear, northern reindeer, arctic fox, lemming, white grouse, northern owl, etc. The southern parts are inhabited by the Manchurian tiger, the Himalayan bear, spotted reindeer, the Japanese ibis, ducks, mandrakes, the blue magpie, etc.,—representatives of the subtropics. On the rocky crests of the mountain ranges are found the ram and the *nemorhaldus* antelope, while the swampy river lowlands and lakes are inhabited by the racoon, the Ussuri mole, and the wild boar.

The fauna of the Far Eastern Territory includes many species and varieties which survive from earlier times when the climate was milder and warmer than it is now. The fact that a considerable part of the area escaped glaciation during the last ice age—and perhaps during several of the preceeding ice ages which wrought such havoc among the fauna of Europe and North America—made possible the survival of animals whose relatives are now to be found in countries considerably further south.

The marked cooling of the climate was a stimulus to the gradual migration of fauna from the more severe parts of Siberia and their sporadic penetration into localities where the climate was more hospitable, mingling with the fauna of a Manchurian transitional region. Thus, the arctic fox and the tiger, the sable and spotted deer, the leopard and bear are sometimes found in a single locality. The Far Eastern Territory, despite its generally severe climate, is the habitat of huge brilliantly coloured tropical butterflies, large callipogon beetles, appropriately called living fossils, poisonous snakes related to the North American rattlers, South-China fish, excellent shrimps, and huge southern mollusks.

ECONOMIC IMPORTANCE

The fauna of the Far Eastern Territory is not only of scientific interest but provides an inexhaustible reserve for practical purposes.

The greatest economic importance must be attached to the many varieties of aquatic animals (fish, mollusks, etc.) and fur-bearing animals.

AQUATIC ANIMALS

As regards its potential fish reserves, the Far Eastern Territory holds first place among the regions of the U.S.S.R., although in size of the fishing catch it ranks second to the Caspian basin. The fishing area of the territory comprises approximately half a million sq. kms., only one-tenth of which is utilised. The richest of the three seas in the Soviet Far East is the Bering Sea, but as regards the catch, the Japan Sea is by far the more important, being the most accessible.

The rivers and lakes of the Far East are of great commercial importance. High-grade salmon are caught here. The following bodies of water are of prime importance as regards fishing: Khanka, Petropavlovsk, Orel Lakes and the river Amur with its estuary. On the basis of data now available, the varieties of fish inhabiting the waters of the Far Eastern Territory are estimated as follows:

Japan Sea	116
Okhotsk Sea	121
Bering Sea	165
Fresh water	72

The following fish are of greatest commercial importance: herring, cod, halibut, tuna, and salmon. Less importance is attached to the *ivassi* (sardine), dorse, mackerel, pilengas, mentai, ugai, smelt, flounder, sea-ruffs, *Uikha.* Herring is caught in great quantities throughout the Far East, especially off the southern coast from Poset Bay to the Gulf of Tartary. Cod, which is highly prolific (according to weight, the female lays from 2,700,000 to 9,000,000 eggs) is also caught in great abundance. The richest cod banks are in the Okhotsk Sea at the Commander Islands and off the southeastern and western part of the Kamchatka coast. Halibut, which belongs to the flounder family, is mainly distributed in the Bering and Okhotsk Seas, but is also to be found in the Japan Sea. Tuna (in Japanese—*magura*), a variety of mackerel which reaches a length of three metres and a weight of 4 centners, is to be found in the Bay of Peter the Great. *Ivassi,* which belongs to the herring family, is caught throughout the summer and autumn, exclusively off the Maritime district as far as the Gulf of Tartary.

Salmon occurs along the entire coast from the extreme south to Anadyr and in all the rivers of the territory. It is especially plentiful in the mouth of the Amur River, which is one of the main sources of salmon in the Soviet Far East. Among the salmon the following varieties are of commercial importance: dog-salmon, humpback salmon, *sima, salmo,* red salmon and *Kizhuch Sima* (Pacific Ocean salmon) which is caught only along the Maritime District, the remaining are found everywhere. Smelt occurs in the waters of the territory everywhere from the Bering Sound to the far south. It enters the Kamchatka and Gizhga rivers. Ugai ("red feather") is the only representative of the carp family in Far Eastern waters. It is caught at the mouths of the rivers, including the Amur, where it goes to spawn. *Minlai* and *pilengas* are local commercial varieties, extremely tasty, which are mainly caught off the Maritime District. Haddock, Far Eastern dorse, is widely distributed throughout the Far Eastern waters and is especially plentiful off Kamchatka. Far Eastern sharks are quite large: the prickly shark attains a length of 110 cms., the herring shark one of 2 metres, the hammer shark one of 4 metres. Sharks are caught in all the waters of the district.

Marine animals come second in importance among the animals of the Far East. Among them, the following should be mentioned: whales (20 varieties) and pinniped (8 varieties). Most of the whales in Far Eastern waters inhabit the Arctic Ocean (northern whale) and go south through the Bering Strait ordinarily as far as 60°. They are most frequently found in the bays of the Chukhotsk-Anadyr district (Kresta Bay, Lavrentiya Bay). The Okhotsk Sea is inhabited by the so-called Japanese whales, while around the Commander and Shantarskie Islands the hump-backed whale is encountered. The following kinds of whale deserve mention: the sperm whale, which descends as far as 40° N. Lat., the orc and the white whale, which are especially plentiful in the Amur estuaries. As regards the pinnipeds, walruses are plentiful in the waters of the territory (in the Arctic Ocean and the Bering Sea); seals are found everywhere, *Yakiba* live in the Okhotsk Sea, and sea-lion in the Sound of Peter the Great. Among the invertebrates of the Far East, the following are of most importance: crabs, shrimps, oysters, midiae, trepans, rectinates. Crabs are caught throughout the Far Eastern Territory. They are especially abundant in Kamchatka (from the Kambalnaya River to the Icha River) and the Maritime District (Sound of Peter the Great). Crabs are one of the largest forms of crustaceans. They are highly valued for their delicious meat. Shrimps occur in tremendous quantities in the lakes of the territory (especially Lake Khanka) and in the sheltered bays (Strelok, Vostok, Nakhodka).

Mollusks inhabit all the waters of the Far Eastern Territory. The most abundant is the oyster. Numerous oyster beds occur in the northern part of the Amur Gulf, Expedition Bay and Poset Sound. The oysters of De-Kastri Sound are considered the best. The small crab *midia* is also found throughout the territory. It is especially abundant on Wrangel, Rimskii Korsakov, and Reinek islands. Doubtless, the most valuable mollusk is the marine pectinate, which reaches a large size and is quite frequently found in the Maritime District. A river variety of this pectinate inhabits the muddy waters of the Amur and its lakes, especially Khanka, in huge quantities. Trepans which belong to the family of sea melons (*holothurians*) of the mobile category occur throughout the district. The Maritime and Okhotsk shores are its points of concentration. The common trepan is from 5 to 6 cm. long and 3 cm. wide. Large trepans reach a length of 20 cm. They live in shallow depths (13 to 17 metres). The most delicious trepans in the world come exclusively from the Sound of Peter the Great. The mountain rivers—tributaries of the Ussuri and the Amur, as well as the rivers of Kamchatka (the Goligina and Zhemchuzhnaya in particular) contain huge quantities of pearl oysters, which cover their bottoms (over 400 per sq. metre). They provide shells for the mother-of-pearl industry, meat for swine and fowl, and pearls.

We have enumerated only the main species of the aquatic fauna of the territory. The fauna of the Far Eastern Territory is unparalelled in its variety and quantity—it is the richest in the U.S.S.R. Special mention must be made of the rich fauna of the inland waters of the territory—the lakes and rivers. Only people who have seen how the fishing nets strain under the pressure of tremendous catches in the dozens of lakes of the Amur basin can conceive of the inexhaustible fish reserves in the depths of the mighty Amur.

FUR-BEARING ANIMALS

The second most important group of the fauna of the Far Eastern Territory are the fur-bearing animals. The main representatives, those having the greatest commercial importance, are: squirrel, fox, arctic fox, ermine, mountain ram, shrew and sable. High-grade fur, pantocrene from the antlers of Manchurian deer and spotted deer, the secretion of the musk-deer and meat, these are the main products of the Far Eastern fur-bearing animals. The Far Eastern Territory may be divided into several districts as regards the commercial importance of the land fauna:

1. Chukhotsk-Anadyr district, where the most important species are: polar bear (on the sea coast), polar fox, red fox, wolf, *sivodushka,* wolverine, otter, bear, ermine, hare, reindeer and mountain ram.
2. Kamchatka—sable, fox, otter, bear, ermine, wolf, glutton, reindeer, wolverine, mountain ram.
3. Commander Islands—sea-beaver, arctic fox, and sea-lion.
4. Okhotsk coast—squirrel, fox, bear, wolf, wolverine, sable, white fox, otter, ermine.
5. Maritime—sable, squirrel, fox, bear, wolf, wolverine, shrew, otter, Amur racoon, badger, lynx, reindeer, spotted deer, wild goat, Manchurian deer, elk, Amur antelope, wild hare, tiger, and snow leopard.
6. Sakhalin—bear, wolf, wolverine, lynx, otter, fox, sable, squirrel, reindeer, musk deer.
7. Amur district—squirrel, fox, shrew, sable, ermine, polecat, otter, bear, wolverine, lynx, hare, Manchurian deer, musk deer, wild boar.

Among the districts of the territory the most important for hunting and fur are the northern (Chukotka and Kamchatka) and the Maritime.

GAME AND FOWL

We have touched only upon those varieties of animals which are of major economic importance. The fauna of the Far Eastern Territory includes many other species. Excellent game fowl inhabit its woods and thickets: hazel-hen, black grouse, wood-grouse, pheasants, and partridge. The waters and shores of the rivers and lakes yearly give dozens of tons of many varieties of ducks, geese, snipe and curlews, etc. The territory has several species of herons, cranes, and forest birds whose feathers are used in trimming women's clothes and hats. During the spring and autumn migrations one involuntarily recalls the words of the famous N. M. Przhevalsky, who wrote of the clouds of birds which hid the sky from the eye of the observer.

The many varieties of fur-bearing animals, fish, birds, sea-animals and mollusks, distributed throughout the territory, testify to the rich animal resources of the Soviet Far East.