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Following is a translation from the Ukrainian text of an article entitled The Mining Industry of the Green Ukraine, written by John V Sweet (aka Ivan Svit). Mr Sweet lived and worked in the Soviet Far East from 1918 to 1951. He is the author of numerous published works on Soviet Far Eastern geography, ethnology and history.

1. General picture of the geological structure of the Green Ukraine. Her principal mineral wealth. The gold mining industry. Coal: its deposits and mining. Iron ore and the metallurgical industry. The petroleum industry. Deposits and extraction of ores and metals. Non-metal deposits. The outlook in the mining industry.

2. The very expanse of the surface of the Green Ukraine presents no small difficulties for research, apart from the unstable nature of the research work and the limitation of materials, especially during the last 20 years. In general, however, a certain amount of positive knowledge has been acquired about the general structure of the country's surface and its sub-surface contents, although information concerning the country's resources, founded on professional knowledge, is still lacking. The information that exists or that which seeps through to us from time to time, does not give an accurate picture of the riches themselves or their exact distribution. Only the gold industry, and in part the coal industry, have been well investigated and then only in the regions that are in contact with populated areas. Sparsely populated areas remain little explored. It is true, however, that actual extraction of something from the ground is a positive proof and beginning which is followed later by geological and industrial exploration of the deposits. During the last hundred years, opinions concerning the structure of the surface and the deposits of the Green Ukraine, speaking from a geological point of view, have undergone noticeable changes, although in the main they have remained the same. The country, on the whole, is mountainous or represents a plateau. Only in the Far North, the Lena River and the lower Amur River are there considerable areas of lowlands which, however, are hemmed in by mountains rising around them.

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3. The best work in world literature that gives a general picture of the geological structure of the surface in the Green Ukraine, though not mentioning the country specifically, is undoubtedly the work of Edward Suess. The third volume of the book contains a synthesis of all that is known about Siberia in general, and the Far East, which the latter includes. Subsequent research and publications are only either supplements or explanations of this fundamental work; for the most part, compilations of various materials; but, again, they base their judgment mostly on the work done during the second half of the 19th century or before the First World War.*

4. The scope of the exploration of Siberia expanded especially during the planning and building of the Siberian railroad, and later, in the work conducted in the Amur, Primor'ye, and Zabaykal'ye regions in connection with the planning and building of railways in these regions. Among the latest works that have appeared in the Soviet Union, the work of the well-known geologist, V.A. Obruchev, deserves attention. In general, however, they are compilations of innumerable materials of various researchers.** The works of the individual authors, researchers, who have worked on the lands of the Green Ukraine, will be indicated in appropriate places.

5. Thus, the terrain to the east of the Yenisei River represents an eastern plateau, surrounded by a gigantic amphitheater of mountains on the south-west, the south, and the south-east, and by another arc consisting of the Verkhoyans Mountains. The terrain west and east of these mountains descends in comparatively narrow strips of land to the Arctic Ocean. A.W. Grabau so describes the country in his article on the migration of geosynclines.***

6. The structure of the whole country bears the imprint of the specific kind of life prevalent there. The great rivers flowing towards the Arctic Ocean, at the beginning of the summer when the ice breaks up, are full of floating ice; their banks are continuously battered by ice floes. Torrents of water from melting snow and ice rush down. All these factors combine in a great leveling operation, tear large lumps of rock and earth from the banks and carry them down. That is why, perhaps, all the rivers flowing north contain deep depressions and gorges. The Lena River, for instance, winds its way in its middle course, through jagged rocks lying sometimes 300 meters deep. Only its lower part flows through a wide valley, which is also confined, however, by the rising hills of the Verkhoyansk range towering in the east.

7. As regards the Pribaikal'ye this term is taken to mean the terrain east of Lake Baikal and the southern part of its shores up to the borders of Mongolia. This is a beautiful mountainous country with a great number of mountain ranges

* Edward Suess, Vol III of Das Antilitz der Erde or the English edition, Suess, E., 1906-1909 entitled The Face of the Earth, Vol II-IV, Oxford.

** V.A. Obruchev, The Geology of Siberia, Vol I-III, Academy of Sciences, Moscow, 1935-1938. This author also gives the history of the geological research in his work containing 4 volumes published in the old days, before 1917, by the Academy of Sciences, 1931-1937, page 213 of bibliography. Unfortunately, this work does not contain very much material on the Far East or the Green Ukraine.

***A.W. Grabau, The Migration of Geosynclines (The National Geographic Survey of China), Vol III, Nos. 3-4, pp.270-350, Peking

and ridges which sometimes run parallel, and sometimes in different directions, or disappear altogether.

8. In the northern part of Pribaikal'ye, in the midst of an agglomeration of mountain ridges, precipices, and deep canyon rivers, in the neighborhood of the source of the Olekma River, begins the system of the Stanovoy Mountains. These mountains do not run in parallel ranges with one dominating one, as is often represented on maps even in large atlases, but rather a system of ridges extending in a general direction from southwest to northeast, with varying width between separate ranges. There is seldom a dominating ridge but mostly a series of saddles or plateaus with swamps. Neither is it a watershed between the Arctic and Pacific Oceans, as one would frequently imagine from the maps.

9. There are several watersheds there, but only in some places are they evident. In the majority of cases, one crosses these ridges without noticing which side is which because the sources of the rivers are close to one another, and some of the rivers flow north while the others flow south or east. The range of the Stanovoy is one of plateaus, partly alpine terrain, and of several mountain ridges which rise and then either disappear along the edges of this mountainous terrain or extend into it deeper and disappear there, or rise and unite again.

10. In the north, the picture is more striking, comprising the Verkhoyansk Mountains and the ridges coming up to them -- for instance, the Cherskiy Mountains and the others -- as if they were a branch of the Kamchatka range, with their picturesque snow-covered volcanic tops numbering 30 volcanoes, of which 12 are active today.

11. It is difficult to give a brief description of the geological structure of such a complicated and vast terrain. We shall touch upon individual spots only, while describing the deposits, and give their geological characteristics. Anyone having a deeper interest in this may find detailed information in a good work by Prof. E.E. Ahnert*, which was printed not so long ago, or in the materials, included in the Doklady Prim. T.P. Palata. 1922 /Reports of the Primorskoy Chamber of Commerce, 1922/ to which, depending on the special requirements or interest, only the most recent data in individual fields should be added. These two books, especially the first -- give a complete picture, drawn by men of great knowledge. The works of Obruchev are in the nature of a compilation, overburdened by countless technical materials, sometimes not too well presented.** His description of Siberia is fuller than that of the Far East.

12. Basically, this last author follows the ideas of Suess (division of Siberia into seven separate geo-morphological parts, with a certain amount of influence by the works of Dr. A.W. Grabau present)***, but his treatment of materials of European scientists is sometimes incorrect and he deals very superficially with the influence of the glacial epoch. Studies of the subject advanced considerably only during the last twenty years, a fact we have already mentioned.

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* E.E. Ahnert-Gornyye Bogatstva Dalnego Vostoka /Mining Resources of the Far East/, Khabarovsk, "Knizhnoye Delo." A large volume with maps, figures, and diagrams, 800 pp.

** W.A. Obrutshew - Geologie von Sibirien /The Geology of Siberia/ Berlin, 1926, pp. 585 and plates and map.

***Dr. A.W. Grabau, Stratigraphy of China, (Geological Survey of China.)

13. Consequently, the territory of the Green Ukraine can be divided into three parts, ie.; the Yakutsk plateau, the Pribaikal'ye -- a mountainous terrain-- and the Zelenyy Klin /the Green Wedge/ with its mountain ridges, valleys, lowlands of the lower part of the Amur River, and the Prikhaynayskiye lowlands.

14. All over that terrain, with few exceptions, the accumulations of magnetic mass play an important part in the geological formations. There are outcroppings of magnetic mass everywhere. Sometimes they cover large areas and are up to 1,000 feet thick. Therefore, the streams and rivers cut deep canyons or chasms, especially among the hills of the Stanovoy system of ranges. Their banks are eroded, and they have many rapids. The plateaus descend to the principal great rivers in terraces and form plains in low areas, as, for instance, the Middle Lena, Aldan, and Vilyny, as well as the upper part of Gilyuy. There are secondary formations within the limits of the Yakutsk heights, as, for example, the /Yakutsk/plateau, and the plateau of the Aldan system, all of which are rich in gold.

15. Pribaikal'ye is essentially a mountainous terrain - a plateau with endless mountain ridges of various heights, divided by wide and deep river valleys. The general direction of the mountains is north-east, and the largest range is the Yablonoy.

16. East of the Olekma River, the system of the Stanovoy range rises to 8,000 feet. It divides the Yakutsk area from the Amur River. The Dzhudzhur ridge is its extension. The northern slopes of the Stanovoy range fall gradually towards the Aldan plateau while the slopes facing the Amur River are steeper and often form chasms.

17. The northeastern heights are formed by the following ridges: the Kolyma ridge (Gidan), the Anadyr Mountains on the Chukotsk peninsula, the Koryakskiy ridges, and the Kamchatka range. The Verkhoyansk Mountains and the high Cherskiy ridge form an arc, which embraces the lowlands of the Yani River and the Oyamiyakon plateau -- the coldest region in the world. These places have an alpine character, with their sharp mountain tops, steep inclines, and traces of glaciers. Ice deposits up to 50 feet thick are scattered on the shores of the Arctic Ocean and on the Novosibirsk Islands, which have been there since the glacial period. They often contain remnants of mammoths and plants of that period, especially at the mouth of the Lena River.

18. At first, we shall examine the mineral wealth in the territory of the Zelenyy Klin proper, namely, the Amur and Primorskiy regions, in the broad sense of the word, because, firstly, the majority of the Ukrainian population inhabits this territory, and, secondly, because the Ukrainians represent an absolute majority of the population in these regions, and can take a more active part in building their life. The mining industry itself has greater chances in the future not only of serving local needs but also of becoming the foundation for foreign trade, while other regions of the Green Ukraine, though also of great value, would always remain subordinate to the Amur-Primorskiy Region, as we shall sometimes designate this part of the Green Ukraine.

19. The Amur region is the entire area ranging from the Stanovoy range north of the Amur River. It is bounded in the east by the Dzhuna River and the coast of the Okhotsk Sea; in the west, the conventional boundary is the Urk River which falls into the Amur River directly from the north, its narrowest part lying between the Amur River and the Stanovoye Mountains.

20. In this terrain, orographically rather complex, the mountain ridges have two main directions: meridional and latitudinal. The Maly [Small] Khingan Ridge runs meridionally, while the Stanovoy system in the north dominates the entire terrain and extends latitudinally from west to east. Its extensions are the ridges of Tukuringra, Dzhanda, land, and several others, especially the watershed between the rivers of Uda and Selemdzha, and the mountainous locality north of the Amgun' River. Between the latter at its source and the Selemdzha River, there are several ridges extending straight, which are supposed to form the northern part of the Maly Khingan.

21. In the southeastern part of the Amur region the direction of the Khingan mountains predominates, especially east of the Bureya River, in such ranges as the Malyy Khingan and the Bureinskiy Mountains, Ukurunra, Chaltin, Tokorey, and Megan ridges.

22. Earlier, before 1908, there prevailed the idea that the last three ridges constituted the northern extension of Sykhotalin', but this idea no longer has any support.

23. The whole system of rivers looks as if it were a supplement to the two main directions of mountains, because the streams flow between the ranges like guiding boundary lines.

24. Before 1894, no systematic investigation of this vast territory had been made. There had been individual expeditions which conducted research and prepared route charts, thus laying a foundation for various kinds of estimates and explorations. For example, the orographic description of the territory of the Far East from the south of Pribaikal'ye to the Chukotsk peninsula was based on the individual research of Prince P. Kropotkin the results of which were published in 1875 in T.U.R.G.O. [possibly, Vol 5, Russian Geological Society] and later with many changes and additions, in English, in 1904.* This work had a great influence on the preparation of maps of Asia, mainly its northeastern parts. During the last 40 years, the basic orographic system has been improved and made more exact -- in some places changed out of all recognition-because at the time of its beginning tables of measurements (chiselni skladniki) were unknown.

25. However, to this day the regions of the Uda River, the lower part of the Amgun' and part of the Gorynya have been but little investigated.

26. In trying to produce an accurate description of the mining industry one cannot skip the details of geological nature in a general summary. The basin of the Zeya River is one of the essential gold-producing localities in the Amur Region. The Zeya River itself, as well as its tributaries, has its source mostly in the southern part of the rising ground of the Stanovoy system of ranges, as, for instance, its left tributaries, the Bryanta River and the Gilyuy River. The difference between the northern and the southern parts of the Stanoyoy system of mountains in geological respects is great. The slopes and the side of the system towards the Yakut region are rich in granite, poor in gneiss, but rich in materials of volcanic origin, such as porphyry, porphyrites, gabbro, and metamorphic schist, as well as a small amount of tufaceous conglomerates.

* Orography of Asia by Prince P. Kropotkin, The Geographical Journal, Jan-Jun 1904, pp 176-206, 331-360, with maps and diagrams.

27. The Amur part, on the other hand, has almost exclusively Pre-Cambrian granites, the outcrops of which occur in veins of pegmatite, and, rarely, porphyritic granite. The sedimentary rocks found in the Zeya basin are from the Post-Tertiary period and occur only in narrow strips in river valleys. Pre-Cambrian gneisses appear on granites in the regions of the Dzhes River -- its lower part -- and the Khnakha and Olongro rivers, forming the foundation of the basins of the Urkan, Gilyuy, and Bryanta rivers.

28. The river, creek and stream valleys are full of deposits of the Post-Tertiary period, sandstone in large-river valleys; and course-grained deposits including gravel in the younger streams and creeks. Gold is present in those alluvial deposits; it used to be panned before, and its production is either in a preparatory stage already or potentially extractable. One can assume, that possibly all rivers, creeks, and valleys similar to these, contain gold which it would be profitable to produce. This possibility has been confirmed many times in practice during the last hundred years. This gold-bearing quality of the deposits is responsible for the wreckage and destruction of dark gneisses, biotites, and hornblende, as well as that of rich outcrops of pegmatite veins.

29. The basins of the Uaya and Bom rivers form a rich gold-bearing region. The development of Pre-Cambrian granites and gneisses continues east up to the Meridional Dzhugdir range, which forms a watershed between the Zeya and Uda Rivers. The basin of the latter is composed in its western part, to a considerable degree of crystalline rock of older periods, while east of it, especially nearer the Okhotsk Sea, deposits of the Post-Tertiary period come to light.

30. In the locality east of the Gilyuy River, between the mouth of the Dzhalinda River which falls into the Urkan River (on old maps, the Ur River), the mouth of the Urkan River and that of the Zeya River, and up to the bank of the Amur River near Blagoveshchensk, gneisses, granites, and other crystalline rocks come to the surface only in a few places in deep valleys of large rivers, or in their tributaries. This is because the surface is composed of sedimentary rocks of the Jurassic period and so-called alluvial deposits, which contain broad strata of fine sands, sandstone, clay shale, and sometimes, lignites (lingyty). These Jurassic strata form a continuous upper layer covering up to the mouth of the Urkan River, while further east they disappear under alluvial deposits which occupy the rest of the territory between the Zeya and Amur.

31. Only in the Zeya River valley, between the mouths of the rivers of Urkan and Selemdzha, and, sometimes, along the Amur River, crystalline strata peep out from under the alluvial deposits. Thus, the thick Jurassic gneiss and granite layer, rich in gold, is hidden under the large thick strata of Jurassic and alluvial rock. For this reason, gold is found here in comparatively small quantities; if found at all, it is mostly in small tributaries of the Amur River itself.

32. A phenomenon of great importance to the Amur region should be noted here, namely, that gold is found here mainly in basic crystalline rocks, in Jurassic and alluvial deposits of a later period. In the process of erosion in that vast territory, considerable quantities of gold were liberated from the crystalline rock, and the rivers, digging in their course deeper and deeper gorges and canyons through Jurassic crystalline rock contributed to the concentration

of gold deposits. At the same time, in Jurassic and alluvial strata, gold deposits became slighter and scattered over large areas, through the entire thickness of the layers.* It is interesting to note, that three pulverizing processes took place in the Amur region during different geological periods; therefore, gold in those deposits is fine and eroded, which is another proof of it having come down from remote places.

33. The basin of the Selemdzha River has its principal gold mines in its upper part and in the tributaries, such as the rivers of Dugda, Mina, Karauraka, and Khargu. It is a curious thing that no Jurassic deposits have been found here, and that directly under the alluvial deposits lies Pre-Cambrian gneissic granite or crystalline and clay shale. Up the river of Velikaya Mina [Great Mine], the alluvial strata disappear and Pre-Cambrian deposits form the basis of the upper part of the Selemdzha basin hiding only sometimes under the deposits of the Post-Tertiary period.

34. Although there is a certain general resemblance between the geological structure of the Zeya and Selemdzha basins which we have described, there are also differences, as for example, the fact that there are few outcroppings of granites of volcanic origin (pegmatites and aplites), that gneisses contain many admixtures of other schistous rocks, like quartzites, chlorites, and, sometimes, clay shale -rooks which are genetically related to gneisses or are the products of physical and chemical changes that take place in the gneisses. In some places instead of gneisses, crystalline schists predominate. South of the Selemdzha River, along its tributaries, granites are significant. This depends, perhaps, upon the mountains which form a watershed between the basins of the rivers of Selemdzha and Udi.

35. In the area between the Zeya River and Malyy Khingan, alluvial deposits play a certain part. They are joined in the east by Jurassic strata, which are of great importance in the Bureya basin. A little towards the north, Jurassic sandstone and schist still predominate and, in the areas near Bureu, they are interlaid with coal, from under which granite strata outcrop, with a general direction towards the north. Beyond the upper reaches of the Bureya River the amount of crystalline rock, such as quartzite, for instance, increases again, while granites are rare, and gneisses are still fewer. The upper reaches of the Zelemdzha and Niman rivers have mostly Pre-Cambrian crystalline schist and a small amount of gneisses.

36. The structure of the Maly Khingan is crystalline in its northern part, while the regions of the basins of the Velikaya Bira River are occupied by gneissic granite, rich in gold. There are no alluvial deposits in this locality; therefore the strata, rich in gold produced by Post-Tertiary deposits, lie either on crystalline rock or crystalline limestone, or on gneisses. The general conditions surrounding the presence of gold in Malyy Khingan are the same as elsewhere, namely, there are rich mines where there is gneissic granite mixed with pegmatities. Where there is porphyry, there is no gold; nor is there gold where limestone, dolomites, and clay shale are widespread.

37. In the case of limestone, however, [gold occurs] only where there are no gneissic granite or pegmatites near it.

* In Australia, gold is present mostly in alluvial soil called "alluvial soil, gold bearing" [in quotation marks in English]

18. We must return for a while to the region of the Niman River, which is important from the point of view of the presence of gold, discovered by Yavorovskiy. He believes the deposits to be alluvial, although of a different nature from those in other localities of the Zelenyy Klin. These alluvial mines are all located in ancient deposits, which may be looked upon sometimes as having been adjoining some ancient Jurassic sea, its shores composed of crystalline rock, rich in gold.

19. In the area east of Malyy Khingan up to the river, Goryn', there are strata of ancient post-Tertiary deposits. Towards the north, crystalline rocks such as crystalline schist, begin to appear; there is a great quantity between the rivers of Amur and Amgun'. In the basin of the left tributaries of the upper Amgun' (Nelimen, Kerb, Nilana), metamorphic schists are strong. They cut through quartzite veins, if there are no granites or gneisses present. However, volcanic rocks are not conspicuous. In the lower reaches of the Amgun' River, and in the very structure east of the 137th meridian, there are many outcroppings of more recent volcanic rocks, such as trachytes and basalts. It is also interesting to note that, except for post-Tertiary and newer deposits, no sedimentary rocks have been found yet in the basin of the Amgun' River.

20. The presence of outcroppings of trachytes and basalts in that area should be noted. They are characteristic of this part of the country, which shows that it is tectonically related to the locality of the Sihota-Alin' proper.

21. The highlands of the Amgun' River and its left tributaries are all rich in gold which is of Post-Tertiary origin since these highlands were formed from metamorphic schists, streaked with veins of quartz.

22. The Ussuri region is the area south of the Amur River and east of the Ussuri River. It has one principal mountain mass, called the Sikhota-Alin' range, stretching in a general direction from the south to the southeast at about one-third the distance from the coast of the Japan Sea to the Ussuri River. Looking at the map of Zelenyy Klin proper, one is impressed by one feature of its orography, for it looks as if it were one great valley beginning at the south of the Ussrui-Amur Bay and stretching northeast, to the mouth of the Amur River and St. Nicholas Bay. Only between the lakes, Chukchagorskoye and Zvoron, in the west, and the Amur River in the east are there no great heights (the 138° meridian crosses the 52° north latitude).

23. As has been mentioned above in the physical description of the terrain, the eastern slopes of the Sikhota-Alin mountains are steep, while the western ones, towards the rivers of Amur and Ussuri, slope gently. This is very strongly reflected in the length of the rivers, some of which flow east and some west. The ones flowing west are longer and have more open wider valleys, than those flowing east. This depend also on the tectonic structure of the Sikhota-Alin range itself. Its average height is more than 3,000-4,000 feet while individual peaks reach 5,000 feet and sometimes a little more.

24. The Ussuri valley has fertile alluvial soil, like the left bank of the Amur River in its lower part, although the lakes and swamps scattered here in parts seem to contradict this opinion.

25. The eastern and western slopes of the Sikhota-Alin' mountains also differ greatly from each other in their geological structure. The eastern slopes of the north, as far as the Balimbeg River, are composed of more recent volcanic rocks, such as

basalts, melaphyres, andesites and their tuffs. Further on, the mountains are composed also of volcanic rock, such as diaryls (diaryty /sic/ **diabase, and porphyrites,** while **gneisses** and syenites begin to crop up. Only further on, towards St. Ol'ga Bay, granites and gneisses, which predominate near that bay, come into view. On evaluating this difference in the structure of the slopes of this range, one must take into consideration the fact, that the eastern slopes are really not slopes but the very range itself in its central part.

46. From the bay of St. Ol'ga up to Vladivostok, all the component parts of the Sikhota-Alin range come more and more to the surface because the coastline here goes through the range itself, cutting it across. No more recent volcanic rocks or any others are noticeable here, only sandy clay shale on the surface with crystalline rocks underneath. Still further, sandstone and various schists slowly blend into the valley, with post-Tertiary and Jurassic deposits of the valley of the Ussuri River cropping out on the surface.

47. The surface of the island of Sakhalin is very hilly although it has no high mountains. The greater part of it is composed of rocks of later periods, mainly the Tertiary period There is very little proof of any quantities of crystalline rocks, such as granites or gneisses being present; for the most part, volcanic rocks here break through chalk or tertiary layers. They are mostly **diorites** and basalts which form the majority of horns jutting into the sea on the western coast of the island. The sedimentary rocks of the island are mainly composed of sandstone, marl, chalk deposits, and the deposits of the mountainous Tertiary system, which includes sandstone, various clays, and conglomerates.

48. The Kamchatka peninsula is formed chiefly of clays and sandstone of the Tertiary period, bearing countless outcroppings of volcanic deposits of basalts and **trachytes**. Massive ancient rocks and **crystallines**, such as porphyries, granites, syenites, and clay shale are encountered only in the southern part of Kamchatka.

49. All mountains in Kamchatka are of volcanic origin. Of a total of 42 peaks, 36 are volcanoes, of which 12 are active and the rest quiescent. The highest peak is the Ichinskaya Sopka /Volcanco/ rising about 17,000 feet. Among the active volcanoes, the Klyuchevskaya Sopka, rising 15,020 feet, is the highest (last eruption in 1946). For this reason Kamchatka is poor in ores, except sulphur and other volcanic minerals.

50. We refrain from a detailed description of the strip of land along the Okhotsk Sea and the Anadyr region, because their remoteness from good roads, except the sea route, their sparcity of population, and their main reserves of various mineral **wealth** in the south already **known**, mark these areas merely as possible future sources, although, perhaps, **of** low productivity. Although the Soviet administration has made great efforts during the last few years to push research and develop production in this remote northern territory, it was not for purely economic reasons, but because their political system requires the utilization of the labor of deportees. After all, it would not be safe to keep them in more populated localities. This is the only explanation for the alleged "great industrial development" of the Far North.

51. The economy of human and production reserves dictates their utilization in more populated centers. Only exceptionally important metals or minerals, if they cannot be produced elsewhere or if their transportation costs are prohibitive, are mined

in remote regions. For example, **coal mining** in Kamchatka or the Anadyr' region can have only two explanations: either there are no facilities for transporting coal from the Primorskiy region or there is a great shortage of it for local needs. While **nearby** Alaska uses petroleum for everything, and only a small quantity of coal for its railroad, Kamchatka and the entire North under the Soviets burn coal--sometimes of very inferior quality--or firewood.

52. All the timber necessary for coal mining, although the quality of local lumber used for propping is also very poor, is cut by prisoners. Petroleum in this part of the Soviet empire is **a deficient** source of energy.

53. We shall describe now the **Pribaikal'ye** region, which in respect to its mountains plays an important part in the economy of the Green Ukraine.

54. As has been mentioned several times before, the **Pribaikal'ye** region has a mountainous terrain. The mountains of the Yablonoy range, consisting of several ridges, dominate a considerable part of the territory. The geological structure of these mountains is complex and not uniform. In the main, they are composed of crystalline and metamorphic rocks, as some maintain, of the Pre-Cambrian period. However, granites predominate, which turn, in some parts, into orthogneiss and rarely into syenites. The rocks which have been formed through the hardening of volcanic lava at the edges of the ridges and in the principal mountain **chains** in the west are composed of various porphyries and porphyrites, with an admixture of tuffs. Basalts are encountered in the **basins** of the Khilok, Chikay, and Karenga rivers.

55. Volcanic penetrations are composed mainly of pegmatites, granite-porphyries, diabases, and very rarely, basalt, Crystalline schists, paragneisses, amphibolites, and quartzites are encountered, as well as occasional rocks which have been altered by a metamorphic process. The valleys of the northern tributaries of the Khilok **River** have Mesozoic deposits, which are also to be found along the rivers of Chikoy and Indogi and in the south of the Chita River in the shape of Jurassian conglomerates, sandstone, and clay, the last containing at times a sublayer of coal. In some places basalts either cut though them or cover them up. As far as the alluvial deposts are concerned, they are found only in a few places.

56. The Yablonoy range is curious from the point of view of tectonic structure. For example, the mountains appear rolled together at the base, yet they have no folds because they are permeated by crystalline and metamorphic schists, which do not run parallel with the **range**, but cut across it, or go in and out at various angles. **It is** thought that this is the result of explosions and displacements, which resulted in magma.

57. Between separate **chains**, secondary synclines are also encountered. They are partly filled with deposits of Jurassic origin and very little of them is still left--perhaps only in deep valleys where the erosion process is not strong.

58. The Stanovoy system of mountains presents today an interesting picture. We have already mentioned and partly described in rather great detail its eastern slopes, facing the Amur region. In its central sector, ie., from 120° to 135° east longitude, there are several mountain ranges of various heights extending parallel; sometimes they converge in parts, then diverge again. Among them there are many highlands of great height. This is one of the most characteristic features of the Stanovoy system of mountain ranges.

59. In this part of the Stanovoy system there are individual summits of various heights, mostly with soft contours. Since they have been subject for a long time to erosion, they are often dome-shaped. Between the rivers of Levaya Dzhalinda and Teksikha,

they have the appearance of swampy highlands with small lakes. In this locality, the slopes facing north are gentle.

60. Lake Toko (1,100 meters above sea-level) is surrounded by a mountainous plateau bounded by a range in the north. Towards the south the Stanovoy system drops in two ledges of high mountains so that some summits are considerably lower than the level of Lake Toko, while the plain of the Zeya River is perhaps 725 meters lower. The peaks near the source of the Zeya River are about 2,500 meters high, or perhaps a little less, while north of the lake only individual mountains are less than 1,800 meters in height. These localities have been visited by many scientists and the majority of them agree in their descriptions. Especially important research work was done by E. Ahnert.

61. The Stanovoy system of ranges, from the source of the Aldan River to the upper reaches of the Maya River, has a structure of a complex geological nature. For the most part it is composed of various gneisses and other crystalline and metamorphic schists, again mostly-Pre-Cambrian and rarely of the ancient Paleozoic era. Among the rocks that are volcanic in origin, there are various granites, syenites, idrialites ((idority [sic]), diabases, porphyries and porphyrites, the latter sometimes belonging to a later era. Outcropping (effusion) rocks, for instance, porphyries and porphyrites, a small quantity of trachytes, and, on rare occasions, basalts, are also encountered.

62. Although younger effusion rocks are encountered in the west they do not predominate, while in the east they gradually gain more ground; further north, along the Okhotsk Sea, they form the basis of the structure. Rocks of sedimentary origin form the basis of the northern chains, and in the neighborhood of the Aldan River there are mainly Cambrian limestone, quartzites, sandstone slates and, where permeated by volcanic rock, porphyries, diabases, and porphyrites.

63. In the region of the upper reaches of the Maya River and in the Yudomo-Mayskiye mountains appear the rocks of the UpperTrias but these are of sea origin as, for example, light sandstone and dark schist with porphyrite tuffs which are sometimes penetrated by various quartzites. On the eastern side, in the region of the Ayan Bay, thick layers of limestone, quartzites, and schists are visible, among which the fauna of the Upper Devonian period is often found. It is said that even earlier periods such as the Silurian may be encountered there. There is more fossilized fauna and flora here, on the coast of the Okhotsk Sea than, for example, in the region of the Uda River. East of the river along the sea shore disseminations of old rocks, among them some with flora, are encountered. There are also Jurassic sedimentary rocks and deposits of schist, sandstone, and, sometimes, conglomerites.

64. In the valleys of the upper reaches of the Aldan River and sometimes in the high highlands, there are continental Jurassic rocks with small coal content.

65. The tectonic structure of the Stanovoy system of mountains, like that of the Yablonoy mountains, is complex. There are penetrations of gneisses and crystalline and metamorphic schists. Old folds are everywhere dislocated, some in the direction of the mountain chain, some across it, but rarely at right angles.

66. Various volcanic rocks crop out in the old folds. The Cambrian deposits form the northern slopes of the ranges lying in folds parallel to the ridge; only in the basin of the Maya River are they at an angle. The Paleozoic, Middle Jurassic and Triassic formations make up the greater part of the folds, or cross the general direction of the system of the Stanovoy mountains. Paleozoics predominated in the Ayan region, Jurassics in the Uda-Tigur and Maya mountains, and Triassics in the Yudomo-Mayskiye mountains.

67. The continental Jurassic part of the western slopes is also strongly dislocated and dips in waves in different directions. In the Aldan highlands the Jurassic system is compact with crystalline schists overlapping.

68. These tectonic peculiarities greatly influence the finding or non-finding of certain valuable deposits underground or affect their industrial value. We shall have an opportunity to touch upon the subject in the chapters on coal and petroleum possibilites. That is the reason why we dwelled so long on the geological peculiarities of the Green Ukraine. In this description we did not depend on one author only but tried to make the best possible synthesis of all that is known to date.

69. The geological unconformity in the direction of the Stanovoy system, and the numerous formations of volcanic effusions confirm the opinion that the surface of the region changed in the process of dislocation, which led to a division or splitting of the layers. There is everywhere a great complexity of elevations and depressions, but on the whole, the entire system has the shape of an arc, the internal side of which faces the basin of the Aldan River, while the external one looks towards the stretches of the Amur region and the shores of the Okhotsk Sea.

70. Considerable changes in the watershed are constantly noticable here. They are not with any single chain of mountains but pass constantly from one range of mountains to another through the depressions between them. It is very evident here that the Stanovoy system is really a series of mountains. At the same time, the southern slopes of this part of the Stanovoy system represent a series of cavings, eruptions [rozryv], and depressions descending to the plain of the Amur basin.

71. Along the line of these eruptions and dislocations, effusion rocks penetrate the surface, forming a volcanic covering and individual streams, which complicate still more the general appearance of the surface. All these eruptions and dislocations are thought to have begun before the Cambrian period, after the Proterozoic dislocation, where the region along both sides of the mountain system sank. This process was (perhaps) repeated during the Paleozoic, Mesozoic, and Tertiary periods, and every time it was accompanied by effusions of volcanic rocks. The last movement possibly took place along the old lines in the Quaternary period, when the glaciation process was going on; however, it never reached the snow line, although the latter must have been rather low here.

72. Although there are virtually no glaciers here now, their presence during the glaciation period is confirmed by many facts, as, for instance, the existence of mountain lakes of oval form, scattered in the hills of the river valleys, and of a series of so-called "greblya" [dike?] and moraines. We have partly elucidated the glaciation problem in another chapter. At the present time, this period is a subject of detailed study and research in an endeavor to establish the changes which took place at that time and were connected with a possible dislocation of the entire globe. A good deal of information is buried in that last dislocation, which might explain the remainder of glaciers on the shores of the Arctic ocean, in the region of the delta of the Lena River, and on the Laptev Islands, as well as the exceptional fauna and flora, especially on the territory of the Zelenyy Klin proper, chiefly in the Ussuri region.

73. The western side of the Stanovoy system of mountains represents a watershed between the tributaries of the Okekma and Vatima rivers, on one hand, and the basin of Lake Baikal on the other. We make reference here only to the eastern and partly northern shores of the latter. This part of the Stanovoy system has two--sometimes three--chains of mountains, divided by meridional valleys of various river systems. The

peaks of individual mountains in these chains are considerably higher on both sides of the system itself. It should be noted, that the highlands of the Tsip River, and especially the valley of the Barguzin River in Pribaikal'ye at the western end of the Stanovoy system and at the beginning of the Khamar-Daban [mountains?], are characterized by the presence of a great number of hot mineral springs. This is because the mountains of this region--the west--are younger. The great scattered shelves of basalts and volcanic craters of the Quaternary period seem to indicate more recent eruptions.

74. The extension of the Stanovoy Mountains running west from the Okhotsk Sea, near the Okhota River, is called today the Kolyma range, and the ridge which extends from this junction northeast is called the Anadyr ridge. True, the excursions carried out for research purposes during the last twenty years do not confirm the opinion that the P. [?] Anadyr mountains constitute an extension of the Stanovoy system; they are rather an independent system of ridges.

75. The Yudamo-Mayskiy watershed is composed of Triassic rocks but of sea origin, as has already been mentioned in the description of the mountains near the Okhotsk shores. This characteristic feature of the Yudamo-Mayskiy range is altogether alien to the Stanovoy system. The range itself issues from the Stanovoy system at a sharp angle, along the Yudam River, and is composed completely of effusive rocks, such as diabases, diabasic porphyrites, and quartzite porphyries.

76. The Verkhoyansk Mountains are of the Pre-Cambrian and old Paleozoic periods and in their structure resemble somewhat the mountains in the Aldan basin. In the east they were superimposed with Triassic deposits of sea origin, which seems to connect these mountains with the Yudamo-Mayskiy watershed. At any rate, their exact directions and their structure have not been properly investigated. The works of Yerman and others are not final. One thing is certain, and that is, that these mountains are not an extentions of the Aldan chains or ranges, as was formerly supposed.

77. The Kolyma range is not connected with them either, but forms a kind of arc composed of several meridional ridges. Expeditions under the leadership of S.V. Obruchev conducted explorations of these mountains in 1929 and later but [no information resulted] except a general statement to the effect that granites and metamorphic schists, in many places intersected by sea Triassic, were encountered there. The survey of the terrain along the Kolyma River, or, more correctly, its basin, has not yet been completed, and it requires not only further systematic research but also a certain amount of synthesizing, since all the works that have been published speak for the most part of the general and approximate directions of the ridges and give their names or indicate their components for lack of detailed information.

78. A typical detail of the latest published materials at our disposal is that even the results of such old surveys as those conducted by E. Ahnert at the turn of this century, were not properly checked in 1936 and 1937, when V.A. Obruchev's work, a compilation of all that was known about East Asia and Siberia, was published. A general picture is sketched on the basis of even earlier surveys. Only the details of the individual areas which had been prospected for various sources of ores or other minerals, have been worked out. But on the whole a great deal of work and good specialists are needed in order to draw a true picture of the geological structure of the Green Ukraine.

79. At this point, we consider our general description complete, and we shall pass to the description and characterization of the strata of various minerals on the entire territory of our land and of the present state of the mining and manufacturing industries connected with them.

The Coal of the Green Ukraine

80. We shall begin with a description of the general coal deposits and their peculiarities, and our next concern will be the present mining and utilization of coal as fuel and in the chemical industry, which, so far, is in a rudimentary stage in the territory of the Green Ukraine.

81. Unfortunately, our personal experience concerns only the mines of that time, which the author had an opportunity to visit in the Summer of 1922, and a few others nearby, which at that time did not play as important a part as they do now. The observation of the Fushun and Malin mines in Manchuria makes it possible for us to compare and outline future possibilities. The results of it have been partially published in separate reports.*

82. The works of E. Ahnert and the geologist, A.N. Krishtafovich are, perhaps, the best of all on the coal industry, chiefly the deposits. They give the best analysis of the conditions necessary for finding the coal strata, as well as further prospecting on the entire territory of the Amur and Primor'ye regions. Side by side with this E. Ahnert wrote on other subjects. His chief contribution was to the gold industry. He is also the author of a major work entitled Gornyye Bogatstva Dal'nego Vostoka. /Mineral Wealth of the Far East/, which is, perhaps, unique. We have referred to it before.

83. Of all the territory, the Primor'ye region and, partly, Sakhalin Island are most important as coal terrain, the deposits of which play an exceptional part in the economy of the whole country. Other coal deposits are only of local significance, as a source of cheap fuel. The Primor'ye and Sakhalin deposits are so important because of their accessibility for transportation over long distances and because their quality is better here than elsewhere.

84. The basic mines of the Primor'ye region are those of Suchan and Artem, formerly Uglovy mines, near the station of Uglov, 25 or 30 kilometers from Vladivostok.

85. Deposits of good coal are located along the Suchan River, which falls into Nakhodka Bay. There are two kinds of coal there: at the western end there are semi-anthracites, which yield good coke and possess good steam-producing qualities; at the northwestern end, beyond the Sitsya River, coal is fat, with a long flame. Between these two main qualities, there is coal of transitional grades. The trouble with Suchan is that the coal layers contain many dislocations and faults, and extend, for the most part, at various, rather sharp, angles. The principal layers have a 45° angle of dip; very often the angle is 60° to 80°, and, according to the materials of Reutovskiy, even 90°. Besides, the semi-anthracite supplies are insignificant amounting to 5-7 percent, perhaps 10 percent of the total. The coal reserves on the Suchan are not too large. They were estimated at the beginning of the First World War, taking into account a depth of not more than 90 meters, to be about 10,000,000 to 12,000,000 tons. According to the materials of M. Yeliyashevich, Vitenberg, Krishtafovich, and Preobrazhenskiy, the strata suitable for mining

* I. Svit

stretches down to 250-250 meters with nine layers of coal, of which four are now being mined. All that coal belongs to the Upper Jurassic period and lies among rocks of yellow and whitish sandstone. The coal of the adjoining mining regions, such as Konstantinovskiy, Podgorodnyy, Lipovetskiy, etc., belongs to that series too. Schists permeated with coal tars are also encountered here.

86. The sharp angle of dip of the layers makes mining extremely difficult, and the safety of the miners is also considerably jeopardized. The mobility of layers limits the procedures to a comparatively small area, while new directions must be sought continuously. Without costly drilling operations no long range production can be planned. Up to the end of the 'thirties' transportation also presented great difficulties. Coal from the Suchan mines was carried to the station of Kangans, which connects with the station of Ugolnaya of the USS. [Ussuri?] railroad by a separate norrow-gauge line running through the mountains. This line has two mountain transmission points (peredachy) which use steel cables for lifting and lowering low-freight cars, weighing about 4 tons each. This line, which is [illegible] of low productivity, is about 70 kilometers long. Later, an ordinary railroad line running to the Nakhodka bay was built. It is equipped for loading coal onto steamers for further transportation.

87. The coal deposits near the Uglovaya part of Amur bay are in a much better situation. There are about 40 square kilometers of them, all of a brown color, part of them mixed with tar, suitable for coking, and at an easy angle of dip of 15°. Other coal mines--Podgorodnyye and the adjoining ones--have better qualities of coal but, again, with a great mobility of layers. The magnitude of the deposits and their favorable location near a railroad made a great development of coal mining here possible. At present, this principal coal base of the Primor'ye operates under the name of the Artem mines, producing three times as much coal as the Suchan.

88. The following coal group is called the Mongugayskaya. It belongs to the lower Jurassics and has an average thickness of 1,800-2,000 meters, of which about 225-250 meters of thickness are productive. The coal lies amoung [illegible] deposits of solid sandstones and sandy schists and coal itself. These deposits were partly mined near the Mongugay River, but the problem of transportation makes it difficult. It is interesting to note that the best materials on coal research written by the above-mentioned authors were later published abroad.*

89. We wish to point out here an important property of coal in the Green Ukraine, described by E. Ahnert in his work.** It is its suitability for coking which makes it useful for industrial purposes. Artem coal is not very suitable; Tavrychanskiy is poor; Suchan part 1 is unsuitable; Suchan part 2 is one of high quality. The situation is the same in other mines. Konstantinovskiy coal is poor; Lipovetskiy coal is unsuitable. There is no coal for coking in the Pribaikal'ye region. On the whole the majority of the better varieties of coal belong in the Far East to a series of the Jurassic period.

90. There are certain data which permit us to maintain that coal deposits exist in many places of the sea coast, beginning with Suchan and up to De-Kastri Bay, but good literature on the subject is so far lacking.

* Dr. Thore G. Halle, Stockholm
** E. Ahnert-Memoirs of China, pp 207-208

91. As far as coal on Sakhalin Island is concerned, there are rather large and valuable deposits there, which extend from the north to, perhaps, a southern part--or rather to about 48° of 50°--of north latitude, along the western shore. There are scores of deposits there, although a part of them belongs to the lignites, apparently Pre-Neocene. The best coal is located near the port of Dusyake. It belongs to the Paleocene era and is found amid schists mixed with sandstone and numerous layers of bituminous coal. The deposits are 18-22 meters thick on the average. Mines are in operation at Duya, Voyevoda, the cape of Rogatyy, Pil'vo, and Vladimirovka.

92. Some of the coal in this region also belongs to the Cretaceous period, and the deposits run among sandstones and schists. The coal deposits among schists reach 8-11 meters of thickness and contain considerable flora. These are the mines: Duysko-Nevelskiye, Niklevich, Petrovskoye, Nanai, and those near Agnevo.

93. These good coal deposits have the same origin as brown coal, but they have undergone considerable changes caused by pressure and heat, where the processes of effusions of volcanic rock took place in this locality. The latter led to certain dislocations, breaks, and partly to a change of angles of dip, sometimes up to 60°. The same volcanic process strengthened the sandstones and schists, and thus facilitated the production of coal at this time. The coal reserves are considerable there, perhaps, the largest in the Green Ukraine. Coal in the Duya region belongs to a gas variety, with a long flame, and it produces clinkering coke. One may hope that the deposits of brown coal in the places where volcanic processes had been more active also improved. Such deposits can be discovered later when the geological research works are more extensive and detailed.

94. The difficulties of transport to places of consumption constitute, however, a considerable obstacle to a great development of coal mining on Sakhalin Island. The shipping centers on the western shore are very poor, because of the lack of bays or quiet, deep rivers, or anything similar. The Tatar Strait dividing the island of Sakhalin from the mainland is rough and fogs are frequent there. All this presents great difficulties for navigation, and, consequently, for shipping coal.

95. The Amur region has two varieties of coal. The first one, consisting of very soft and highly inflammable lignites, is found in the upper part of the region; [ the second ], good coal of the Jurassic system, is in valleys of the rivers of Bureya, Velikaya Bureya, and others.

95. The Kivdinskiye mines and the mines of the Bureya and Bira are located there. The Kivdinskiye mines, however, are the most important, together with the nearby Raychikhinskiye mines. Until 1930 no good prospecting had been done there; later, attention was paid to the Raychinkhinskiy deposits, and their mining was begun. In this locality, the Jurassic deposits have four considerable layers of black coal, with a very long area of coal occurrence, up to 170 kilometers long, but the layers are not very thick. About 40-50 years ago, it was thought that there was no coal of industrial significance in this locality, but no detailed research was conducted then. The coal of the Bira mines belongs to the gas variety and yields up to 63 percent coke, although with a considerable quantity of ashes. The Bureya coal seems to be better. We lack proper analyses but, comparing it with the Bira coal, one may, perhaps, venture such a statement. Coal from this region is used for local consumption and some of it is delivered to Khabarovsk. On the whole, the Amur region is not rich in coal.

96. As far as Kamchatka is concerned, it has, in general, few coal deposits, and those that do exist have no thick strata and thus cannot have any industrial significance. As fuel for the heating of houses this coal can hardly compete with firewood, of which there is, anyway, enough for local needs. Brown coal deposits are encountered in the region of Uda Bay and on the Tayganovskiy peninsula near Kamchatka, as well as on the shores of Penzhinskiy Bay, but they are not thick, about 3-4 feet only, which hardly permits economic production, especially in view of the poor quality of coal. There are also coal deposits on the Chukotskiy peninsula and several other places: Onemen Bay, near the St. Denis Mountains, and in Mechigmenskiy Bay. The coal there, however, is of poor quality and the layers are not thick.

97. There are rather good coal deposits in the Pribaikal'ye region, most of them being brown varieties. The best deposits are in the following regions: Tarbagatay, Khalyartinsk, the Chernorskiye mines near Chita, and the Arbagarskiye mines near Nerchinsk. The layers of the Chernovskiye mines are rather thick, quiescent, without water, and close to the surface; therefore, the greater part of coal is mined by open methods. Coal from the place called Bukachacha, north of the Shilka River, has a special industrial importance and is suitable for coking. The Chernovskiy coal is also used by the Pribaikal'ye railroad.

98. With reference to coal reserves, they are estimated by different authors differently. One must take into consideration the time when those estimates were made, because during the last 30 years new deposits have been discovered, or the deposits that used to be considered poor have been transferred, after investigations, into the category of good, or satisfactory. We have at our disposal only 3 estimates: the first one made in 1920, the second one in 1928-1929, and the third one in 1937-38. The materials of 1928-1929 contain the following table:

| Coal | Brown | Black | Anthracite | Total |
|---|---|---|---|---|
| | | (in millions of tons) | | |
| Pribaikal'ye region | 167 | -- | -- | 167 |
| Amur region | 416 | 2 | -- | 418 |
| Primorskiy region | 157 | 195 | 25 | 377 |
| Sakhalin Island | 25 | 2,075 | -- | 2,100 |
| Kamchatka/Chukotskiy | 52 | | | |
| | | | Total | 3,062 |

99. The annual production of coal in 1921 amounted to 803,000 tons only, compared with 969,000 tons in 1926. About 750,000 tons were used by the railroads, which shows what a small quantity of coal was used for industrial purposes and for the heating of houses, the latter exclusively in large cities because elsewhere firewood is used. We are in possession of some data showing the speedy development of the coal industry in connection with considerable capital investments made in it after the Five-Year Plans. For example, in 1938, the production of coal on the entire territory of the Green Ukraine amounted to about 7,000,000 tons divided as follows: The Buryat-Mongol Oblast and the Chitinskaya Oblast----450,000 tons; the Yakut region---50,000 tons; and the Amur and Primor'ye regions together ----6,500,000 tons, where the bulk of the production is produced by the region of the Artem mines, followed by the Suchan region producing about one-third of the production of the former. These data do not include the amounts produced by individual mines; therefore it is impossible to ascertain exactly the qualities produced. It is known only that the greater part consists of the brown varieties of coal of low productivity.

100. During the post-World War II years it was planned to double coal production in the

territory of East Siberia, including the Green Ukraine, to increase it from 10,300,000 to 27,000,000 tons, but to date the situation is not yet clear. Especially great hopes were put in the coal deposits near Ondo, not far from Komsomol'sk on the Amur River, which is building up heavy industry. During the past few years this town used coal brought over a long distance from Sakhalin and the Southern Primor'ye; during a certain part of the year transport was suspended.

101. Such are the general situation and prospects of the coal industry. It should be added, that during the years of 1945-1947 coal was exported from Vladivostok to Shanghai, China, and perhaps to other places. Before the First World War Sakhalin coal was available in foreign markets and was widely used for shipping. In any case, the Green Ukraine has a good fuel base for its own industry, as well as some coal for export to foreign countries, although there it would meet with competition of better varieties.

102. The development of the iron-producing and iron-working heavy and light industries is closely related to that of the coal industry. Before the First World War these industries were in their beginnings, and only in the Pribaikal'ye region did they have a past, and some experience. For the rest of the territory of the Green Ukraine, this is a new activity.

103. Although at the beginning of this century it was generally thought that no good iron ore deposits could be found, there were, however, indications that the ore from the neighborhood of Nikolaevsk on the Amur River would have the best chance as a foundation for the heavy industry. It should be remembered, that in the construction of the Ussuri railroad, as well as of the Eastern Chinese railroad through Manchuria, American rails were mostly used, because the transportation from the Ukraine was too expensive.

104. The Pribaikal'ye region has rather considerable deposits of iron ore, some of which was mined in the old days and constituted the main supply of individual plants in this area. The first iron-casting works were built in Petrovsk in 1789 and used the ore from the Baleginskiy deposts, magnetic iron ore with the reserves amounting to about 400,000 [ measurement not mentioned ] of pure metal. There are ore deposits in Berezovets, north of Nerchinsk. Ore is also mined from Balbagarskiy deposits in the valley of the Kurba River, a tributary of the Udi River.

105. There are deposits of iron ore near the Botoma River, which flows into the Lena River, a little distance beyond Yakutsk.

106. Along the lower stretches of the Amur River near Nikolaevsk, deposits of brown iron ore, 1960 r. ZZ, have been found which have been well investigated by Bogolyubskiy. These deposts are close to the surface and even appear on the top of it, and their layers are quite thick, with a 43 percent content of pure iron. This ore has a number of good qualities: it burns well; it is situated on the banks of the Amur River and therefore may be processed with the aid of Sakhalin coal, although under the pressure of the Five-Year plans the great iron and steel works in Komsomol'sk use, for the most part, coke and coals from the Bureya basin. There are also iron ore deposits near Sofiysk, along the lower stretches of the Amur River, but little is known about their size or utilization. In the environs of the Amur River there are, in general, iron ore deposits in many places, but their amounts are too small or poorly concentrated to warrant expenditures for their exploitation, which would be uneconomical.

107. As regards the iron ores of the Primor'ye, they occur north of St. Olga Bay, in the form of magnetic iron with a content of pure iron amounting to 56-61 percent. These iron reserves are quite vast, amounting to up to 2 million tons. The iron ores were first discovered and investigated by Bogolyubskiy. These localities are currently being exploited. Smaller deposits of iron ore occur also along the shores of the Primor'ye, as well as in the Ussuri valley itself. However, in the latter region these ores are of very poor quality.

108. Reserves of iron ore are found also in the north, as for example in Kamchatka, near the Vagil'ta River. This ore is poor in quality and probably of no industrial significance. Iron ore deposits probably exist in other localities of this region, but their remoteness from good roads acts as an obstacle to their exploration, and even more, to their exploitation.

109. One might add, perhaps, that iron ores occur also in places on the island of Sakhalin, but their quality and quantity are very insignificant.

110. Thus, in the Baikal area (Pribaikal'ye) there are only two ore deposits of any industrial significance, namely, in the Amur region---or, more exactly, the lower Amur, Nikolaevsk, and Sofiysk--and near St. Ol'ga Bay. Iron smelting, in 1913, took place only at the Petropavlovsk plant, in the amount of 10,000 tons, whereas in the whole Zelenyy Klin it amounted to 340 tons. In 1940, ie., before the war, iron smelting in the Pribaikal'ye had reached the figure of 35,000 tons and in Zelenyy Klin, about half a million tons, because the largest capital investments were placed in the latter, namely Amurstal' [Amur Steel Works] at Komsomol'sk.

111. These facts form the basis for the rise of the metal working industry, the building of new-type machines, and the growth of its main industry, the military heavy industry, in the city of Komsomol'sk, as well as its numerous shipbuilding yards.

112. At any rate, this heavy industry has perspectives for future developments in the Green Ukraine and may become a good pillar for the future [economy], especially if one considers that it can be used for the good of the population and for foreign trade, as well as the construction of new roads, of which the region has so few. Likewise, it can be utilized for the building of sea and river ports and transport, not to mention other enterprises in the national economy.

113. The total reserves of iron ore on the territoy of Zelenyy Klin alone are, according to the figures of E. Ahnert, 11 million tons. Moreover, he states that the largest deposits consist of hematites. Unfortunately, we do not have on hand information which might give a more detailed picture of the ore deposits in each specific locality. *

* For purposes of clarity, we offer a description of the iron from the viewpoint of their industrial use:

[Note: At this point (p. 27) two lines become illegible because an awkward insertion of three other lines has superimposed them on these lines, however, the remainder continues as below.]

hematites, which are more widely distributed and lend themselves more easily for processing. The presence of phosphorus, however, diminishes. Therefore,

the ores fall under the categories of phosphoric and non-phosphoric. A maximum of 0.001 percent of metallic ore is allowed. The presence of lime is estimated as plus. Ore containing less than 30 percent iron is difficult to process. In special cases, when it is completely lacking, poorer ores are used, such as 40 percent ores; but in such cases, concentrates are used, and various methods, such as washing, calcination, ventilation, and others are employed.

114. The use of water transport over the Amur River accounts for the good and economical expansion of the iron industry, if one considers that the navigation period of the regions below Blagoveshchensk is 190-210 days annually and below Khabarovsk, about 180-190 days. For this reason, the river transport system is faced with the problem of transporting the greatest amount of cargo in the shortest possible time. However, just as the transport of iron ore over Lake Superior from the port of Duluth to Chicago, Detroit and the Pittsburg environs manages to overcome exceptional problems of navigation through the use of large steamboats and barges, so it is possible also here, although the Amur is not as navigable as the US lakes. One thing is clear, and that is that water routes alone can give the cheapest form of transport, especially if modern, mechanized equipment is used for loading and unloading, instead of forced labor.

115. Heavy industry is already growing up between Blagoveshchensk and Komsomol'sk and, therefore, water transport is used in this region, the most navigable part of the Amur. On the average, water transport here is feasible 200 days of the year, and the remainder of the time the railroad can be used. The transport of ores from the St. Ol'ga area and from points along the coast of the Primor'ye is carried on today by sea, but there is a plan to build a railroad line, although this construction will meet with a number of technical difficulties, such as the crossing of part of the Sikhote-Alin mountain range and the utilization of the stream valleys on both sides of the range, which approach each other quite closely in this vicinity. True, these stream valleys on these heights, except for those of the Avvakumivka River, are narrow, but these constitute the best route for crossing westwards toward the tributary of the Tabakhoz River, if the neighboring forests, as well, are utilized.

116. At present, there exist in the Green Ukraine the following big plants based [sic] on heavy industry: the Ulan-Ude Locomotive Plant, the railroad repair plants in Chita, Khabarovsk, and Komsomol'sk, and the railway-car and repair plants in Ulan-Ude, Khabarovsk, Vladivostok, and Nikol'sk, where during World War I shops were installed for the assembly of large-type locomotives. There are building and repair plants for river steamboats in Sretensk, Blagoveshchensk, Khabarovsk, and Komsomol'sk. There are special repair plants for seafaring coastal steam vessels in Nikolaevsk-on-the-Amur, and De Castri as well as in Magadan, Petropavlovsk in Kamchatka, Klyuchevsk and Vladivostok, the last-named of which has big plants for the building and repair of war vessels, and special plants in Novik Bay on Russkiy Island.

117. There are machine-building plants in Chita, Khabarovsk, and Komsomol'sk. In addition there are special military plants for tank armor and other items in Ulan-Ude, Blagoveshchensk, and Khabarovsk and numerous plants and factories in Komsomol'sk. The last-named city had, in 1939, 27 plants for the production of various types of armaments. In addition, there are plants for the production of airplanes in Ulan-Ude and Khabarovsk; the latter has special plants and factories for the production of various parts and mechanisms for the aviation industry.

118. Already, the iron and steel industry of the Green Ukraine is today the foundation for many different types of machine-building. Moreover, in all the plants enumerated above we see no indication of special plants for the production or partial assembly of machine tools, machines, and attachments for the equipment of saw-mills, the main branch of industry in Zelenyy Klin, or for machines for the gold-mining industry. Later, in our survey of other branches of industry we shall offer certain information in this regard, In any event, the

possibilities are quite considerable, and there is a potential market abroad, once the internal market has been satisfied.

119. The proper organization [presumably, of the iron and steel industry], especially, the smelting of iron and steel, will require coke, the production of which yields gas as a byproduct. The latter may be widely used not only in industry but for domestic purposes. An up-to-date organization of coking and gas plants may become a valuable source of supply for the electrical industry, particularly, a source of electric power. A clear example of this are the cities of Fu-shun and An-shan in Manchuria, where proper organization brought about great achievements in the years 1918-1945*, for, afterwards, the most important and most valuable equipment was transported to the Soviet Union as war booty, and the Chinese people suffered this loss despite the pact of friendship and other commitments.

120. Coking yelds considerable quantities of gas, ammonium, and other chemical products which are important to the national economy. The ammonium group is particularly important as fertilizers in agriculture and as a source for the production of explosives, which in addition to their military value, are also valuable in mining. As regards the gas produced in the coking ovens of Fu-shun, it was sent as fuel to the electric power stations, whose power was distributed to very distant localities. In the Green Ukraine, there is indeed only one and very important installation, of a different type, where the gas used is derived from the buring of coal under ground. This takes place in the Pribaikal'ye near the Gusinoye Sea, but this represents the first such attempt in Asia.

121. Gold has been since ancient times one of the most important sources of income for this region and remains to this day an important factor in the foundation of the national economy of the Green Ukraine in its international relations. The Soviets exploit this source for their own purposes, which have little in common with the welfare of this region, where it is mined.

122. The total amount of gold which is mined in the Green Ukraine was as follows:

| | 1910 | (in kilograms) | 1940 |
|---|---|---|---|
| Yakut region (Lena basin) | 19,950 | | 75,200 |
| Amur region (Primor'ye | 17,024 | | 56,000 |
| Total | 36,544 [sic] | | 131,200 |

123. Unfortunately, there are no data available about the gold mined in such regions as the Far North by the so-called Dal'stroy, which operates north of Okhotsk, mainly in the Magadan-Kolyma area---and which uses the labor of political prisoners and other deportees under the aegis of the NKVD.

124. The total gold reserves in the territory of the Far East alone, according to the data of E. Ahnert, amount to 6,516 metric tons. His estimates, confirmed by Gudkovyy, another expert who is familiar with the numerous Far

*"Coal, Iron, and Electricity on the South Manchurian Railway in The Economic Bulletin 1924, Part 30, pp11-18. An article by the author, I.C.

Eastern localities that are rich in gold, are based on very careful calculations, which take into account the thickness of the **strata** of the alluvial gold-bearing deposits as well as the quartz content.*

125. Gold in the Green Ukraine is obtained chiefly in the alluvial deposits, and gold with quartz **content** is found very rarely, although the possibility of future discoveries is not excluded. However, since the extraction of gold from quartz demands large capital expenditures and good workers, the exploitation of so-called pulverized gold will play a role of ever increasing importance. Such gold is found in the sands and the stream valleys. The main center of the gold extracting industry, today, is situated in the Aldan basin, which constitutes one fourth of all the gold mining in the USSR. Communications in this area take place over a road built from the station of Skovorodino on the Amur railway line, through Tindinsk and Chulman in the Yakut region, and Tommot-Aldan, to Yakutsk itself.

126. During World War I, the center of gold-mining was Bodaybo, but it seems that today Aldan ranks first, because the former source has been exhausted by long years of exploitation.

127. The Aldan gold prospects constitute, in reality, a large number of individual points and localities in the basin of the Aldan River and its tributaries, such as Seredniy [Middle] Serebrovsk, Orochen, Dzhekonda, Nizovyy Orochen, Seligdar, Usmyun, and Spokoynyy. In the majority of these places gold has already been mined by so-called "prospectors". There are also good gold deposits in the Yakut region, which are currently exploited in the valleys of the Verkhnyaya [Upper] Olekma and its tributary, Tungir River, in such places as Oktyabrskiy, Itava, etc.

128. A little north of the Aldan River, along its tributary, the Allakh-Dzhun, [probably another version of Allakh-Yun'] are the eastern slopes of the Dzhugdzhur range. The center of this region is Allakh-Dzhun, on the Yakutsk-Okhotsk highway. The latter basin is undergoing considerable development, and in addition to the prospects which were there at the beginning of the war---such as the Batelinskiy, Burkholinskiy, Yevkadzhinskiy, and Incha--- there are now Yur and Yeldikan.

129. The use of forced labor, as has already been indicated, has led to the development of gold mining in the area along the Magadan-Kolyma [water] route, where numerous mines and prospects have been established. Their condition and the composition of the ores, except for those of the Aldan area, are little known, because they are all under the control of the NKVD and therefore are not subject to any reports, much less to description in scientific and other publications.

130. We shall pause a little longer to consider the gold-mining industry of the Amur and Primor'ye regions because it is situated closer to populated places, has better roads of communication, and has been longer in exploitation. Before we do this, however, we wish to emphasize that the Aldan deposits are considered today to be the richest in the whole of Asia. Therefore, they are even more important than those of Bodaybo or any others.

131. In the Amur region, in particular, gold is widely distributed and may be found in the sand of all the streams of this region, [as, for instance], in the rayons of the Zeya between Gilyusm and Bryanta; in the upper stretches of the Zeya River itself; in the environs of the Stanovoy mountain range; in

* E. Ahnert-"Mineral Resources" in Geological Society of China vol. 3, p.128

the upper stretches of the Mogal River; and, directly opposite the latter out across the Stanovoy Mountains, in the Yakut region. It may also be found on both sides of the Dzhalin mountain range, along the upper stretches of the Arga, Urkan, Ongda, Selemdzha, and Niman rivers and along the river, Amgun, and its environs (Kerbi).

132. Descriptions of the gold industry in the Amur region, written at the beginning of this century, divide this territory into four gold-bearing regions (rayony) the Verkhovin (Amur), Zeya, Niman, and Khingan. The Uda and Amgun regions belonged at that time to the Primor'ye. The Verkhovin region, from the borders of Pribaikal'ye in the west, and from the Stanovoy Mountains to the beginnings of the Zeya region in the north, had at that time seven gold-mining prospects operating successfully and fifteen in the preparatory stage. The latest data indicate that the best prospects in this locality are to be found in the valleys of the Yankan River and the tributary of the Olday River. These yielded in a short period of time 5,564 kilograms but afterwards, this rayon began to yield gold, and the center of gold-mining moved to the Zeya region.

133. The Zeya region has four groups of prospects: the Dzhalin group, the eastern side of the Uankan mountain chain, the Ura stream (Urkan on our map), the Dzhalinda, and Ingagli. The extent of the gold reserves in this region may be gauged by the fact that in the period of 1867-1899 there were extracted 37,104 kilograms under conditions in which the average gold content was only 7 to 10 grams per ton of ore. As may be seen, the deposits were not very rich but the conditions under which gold-mining was carried on were very favorable. Complete data are available concerning the gold yields for the years preceding the revolution, when they did not constitute a "secret". However, we do not have complete data concerning all the gold mined in the Zeyskiy Rayon.

134. The Nimans region has good deposits of gold-laden sand, and the richness of these sands may be gauged by the single fact that in 1901, alone, 23,768 kilograms were mined there. Of this quality, 22,216 were mined in 11 of the prospects in the region, ie., an average of about 2,000 kilograms per prospect. The average gold yield was 10 grams of gold per ton of ore; sometimes it reached 12 to 13 grams. At times there were also yields of 16 to 31 grams--the highest yield. In the remainder of the prospects the mining was very poor, with a gold content of not more than 8-9 grams per ton. At that time, four prospects were considered already exhausted and the remainder had only begun to be exploited. The latest data from that locality still point to good extraction. New discoveries in the neighborhood will increase the potentialities of this rayon. The discovery of other ores in the Niman basin puts gold-mining in a position of secondary importance; nevertheless, it will continue to play a certain role there.

135. The region of Malyy Khingan has a number of gold-bearing localities, chiefly along the upper stretches of the Bureya River itself and some of its tributaries, such as the Sutar, the middle Dychuna, and others, but the amount of gold mined there is not great.

136. In the basins of the upper tributaries of the river, Amgun, such as Nilan, Nemilen, Semi, Kerbi, Kharpuchi, and others, gold has been found and successfully exploited. The greatest amount of gold was yielded by the prospects along the Semi, especially the Pokrov [or Pokrovsk] and the Kerbi prospects. This locality has sizeable reserves and can be easily mined. Here, 6,000 to 7,000 kilograms of gold had already been mined during the first 20 years of exploitation. The Semi prospects yielded approximately as much. As regards the Uda region, it had not been carefully exploited and may still have good reserves because the gold content is 10-12 grams per ton.

137. A curious phenomenon in the Amur and Primor'ye regions--using these names in a very broad sense--is that they have very little gold ore in quartz veins, which does not warrant the expenditure of capital for exploitation. Only in the mountainous areas between the Dzhalta and Dzhaltina, in the Zeya basin, veins were discovered with a content of 65 grams per ton of ore, while in the same area gold dust is to be found in the sand which, quite often, reaches 21-24 grams [per ton], and its extraction is much easier and does not require costly installations.

138. In a final summation, it must be emphasized once more that the gold reserves, particularly in Zelenyy Klin, derive, in general, from Pre-Cambrian crystalline rocks, not from outcropping or bedded quartz veins which, in the majority, have little gold content. It is a typical phenomenon that virgin gold--more than 70 grams--occurs in very small quantities. This proves that quartz veins do not constitute the primary source of gold. The Australian and Ural gold deposits are of a different nature.

139. The Primor'ye--in its narrow sense--has very little gold which is explained by its geological formation. Along the entire seacoast, the mountains are composed of younger volcanic rocks, basalts, porphyrites, trachytes, diorites, ie., non-gold bearing rocks. The western slopes of the Sykhota-Alina Mountains, through they have non-gold bearing volcanic rock, have also gold-bearing crystalline rock such as gneisses, schists, and others. However, in view of the fact that a great valley stretches between the mountains and the Ussuri River, which continues also along the right bank of the Amur River and is 50-75 kilometers wide and is composed mostly of solid Post-Tertiary deposits, there remains only a narrow strip of land with gold-bearing localties between the high peaks of the Sykhota-Alin range and the lowlands. At any rate, very little gold is found there--and in very few localities. Gold is present in the Valleys of the small rivers, Taymigouza, Alchana, Kogotun, Tinkan, and others. Attempts have been made to mine this gold, but they were repeatedly abandoned because there was too little gold even to justify the labor.

140. However, the Ussuri region has two places where gold occurs--on the island of Askol'd near Nakhodka Bay and along the upper stretches of the Tinkan River. The Askol'd quartz veins cut across quartzites, mica, clay schists, and schists of lime, with pegmatities cropping out in some of the granites. The veins range from several inches to 3 feet in thickness with a fall of 85 degrees and have visible traces of movement along the poles and "brikeydzhi" [apparently, a corruption of the English workd "breakage"] "tertya"[??]. The other system of veins does not bear the signs first mentioned and is tightly bound with the quartzite or pegmatite rocks themselves. The presence of gold is 14-15 grams to one kilogram per ton. Gold is found also in the clayey sands near the veins in the amount of 40 to 200 grams. The operations carried on there are done in galleries along the veins. In the first 5 years, up to 35,000 feet were worked by means of galleries.

141. There is gold ore on Sakhalin Island, but the quantities found have been insignificant, and in very few places. In any case, it does not play an important role there. The basic products there are coal and oil. The same situation prevails in Kamchatka, where only in the northern part gold was found in the last few years, but in small quantities.

142. On the strip of coastline running from the mouth of the Uda River along the Okhotsk Sea, gold deposits have been found and are exploited in many places. The principal ones are near the town of Okhotsk. All the localities there, which have gold, are quite poor. The same is true of the Chukotsk peninsula,

which because of its remoteness and the competition on the part of more accessible places, does not and will not play any role of importance, even if it had relatively ample quantities of gold-bearing ores or sand. Gold was found there in Provideniye [Providence] Bay or the river, Olen'ya, and in the veins of quartz not far from the bays of Emma and Plover. In all of these northern localities, gold occurs in connection with the presence of quartz or pegmatite veins in the granites.

143. The gold-mining industry of the Green Ukraine has, in its history, passed through many stages--both development and decline. There are many reasons for this, and they are well elucidated in a special type of literature, as for instance, the works of P. Yavorovskiy and others. At the beginning of the Soviet administration, in 1924, there were 124 prospects in operation in the Pribaikal'ye 69 in the Amur region and 89 on the Primor'ye, which at that time included the Okhotsk coastline, Kamchatka and the Anadyr' area--ie., a total of 382 prospects. We lack data concerning the Yakut region of those days, and we have no data at present concerning the role of each rayon or locality. Only a limited number of prospects and expensive installations, such as dredgers [sic]. In the majority of cases, gold was mined by hand, by washing it in a little cup or trough in primitive fashion. Different writers give a different evaluation to the working methods of these small prospectors. Some frown upon these methods, considering them barbaric, while others say that it is the only proper way. At present, gold mining is all in the hands of the government and the workers there are severly exploited; for the most part, they are deportees. Gold-mining is being mechanized, but this affects only localities that are richer in gold; this has made it possible to increase the gold yields considerably. Indeed, such increases are effected by opening new mines, particularly in the basin of the Aldan River and the environs.

144. All this gives us reason to hope that when the whole gold-mining industry has been properly organized, equipped with the necessary machines, and has passed from Communist control into the hands of a national government, and when the workers' welfare has been properly secured, it will be possible to achieve considerable successes and, thereby, to create a good foundation for the country's entire economy, so that her gold reserves might be used for the benefit of the people and not outsiders, or organizations and other governments.

145. However, the gold industry will require great reforms and broad measures and the transfer to a private basis of operation, with State participation only in the direction of exercising supervision over the conditions of the workers and securing the interests of the country as a whole. But this part of the economy must be in private hands, provided that the interests of those who work there are properly paid [sic] and secured. There are many reasons for this, the main one being that gold-mining will require a certain courage, strength, and conviction that all the disadvantages of life in remote localities are duly compensated and are accepted by working voluntarily.

146. For the technical aspects of gold extraction and the necessary equipment, the whole industry, obviously, will require certain assistance and supervision, and that will be the task of the national government of the Green Ukraine. Life itself will find and indicate the best roads and methods for the achievement of the most desirable results.

Non-ferrous metals of the Green Ukraine and other sources of raw materials for industry

147. Among the other sources of raw materials in the Green Ukraine must be reckoned one of the most important, namely, petroleum and its products, such as gasoline, lubricants, etc.

148. Petroleum is a source of energy for motors of internal combustion, especially in motor transport and aviation. The latter plays a significant role in developments involving great distances where, as a rule, not days but weeks and sometimes months are required to reach a remote destination. Therefore, petroleum plays today and will continue to play an ever increasing role of importance in the near future.

149. How is the Green Ukraine supplied with this type of fuel? A half a century ago, it was considered that petroleum would hardly ever be found in quantities large enough to warrant exploitation. For example, in 1909, the Geological Committee in Vladivostok published some data concerning the investigation of petroleum sources on the island of Sakhalin for the previous two years and indicated that data in regard to the "certainty" of petroleum deposits there were still lacking. All previous soundings, to a depth of 425 feet, had given no indications of oil. In 1922, the geologist, Polevoy, in his work entitled, Reports to the Washington Conference, which we mentioned previously, wrote about the presence of petroleum and the possibility of its exploitation, and he summarized the work accomplished there by various private companies, including the firm of Stakhiavyy. During the Japanese occupation of the island, the Mitsubishi firm and others carried out persistent and deep soundings and the results which they obtained were the foundation for a special agreement with Moscow about an oil concession in the region of the Okha River in the northern part of the island.

150. At the base of the investigations lay the work of Polevoy, already mentioned, and the research work of the geologist, Kryshtofovich and others. There are many such materials and on the basis of these E. Ahnert was able to draw the following conclusions:* in the strata of the Tertiary period, series R-2 has petroleum; this series is up to 220 meters thick. In the Neocene strata there are "horizonty" with petroleum, sands mixed with thin layers of clayey flooring and sands saturated with oil. These sources are already under exploitation in Boetasyn, Nabil, and Okha, or are in the process of exploration.

151. Among the strata, there are also some that contain both coal and petroleum, when floorings rich in coal alternate in places and mix with ores containing petroleum. [Note: The sentence is very poorly constructed in the original and the translation may not be exact]. In all these strata, fauna are to be found.

152. A condition for the presence of oil deposits is the presence also of residual rock. The latter occurs rarely among volcanic and metamorphic rocks. The majority of areas rich in oil today are located in the plains or plateaus of residual formation, which had not been disturbed too much by geological phenomena. Therefore, localities with a predominance of ancient crystalline rocks or severly disturbed formations, with breaks that are larger then the more recent formations--as happens in the greater part of the Green Ukraine and in Central Asia, in general--have a smaller chance of containing oil. This is true also of all volcanic, coral, alluvial, and sea formations in existence

* E.E. Ahnert-Subdivisions of the Jurassic, etc... Maritime and Amur... and Sakhalin...
Report was ready by A.N. Kryshtofovich in Jan. 1923, Pekin, Geol.Sy. of China [in English]

today. As is clear from our geological survey of the Green Ukraine, its territories--especially the areas in the Stanovoye Mountains, situated further to the nor..., and the Pribaikal'ye have the least chance that oil will be found. This is confirmed by the fact that the explorations carried out in certain localities along the projected BAM highway brought no results, although similar explorations were carried on in the valley of the Tolba River*, where it was hoped that oil would be found. The most recent information indicates that oil has been found there.

153. Similarly, oil sources have been found in Pribaikal'ye at the mouth of the Selenga River and along the southwestern shores of Lake Baikal

154. After the conclusion of the agreement with Japan, Moscow made use of the explorations of the Japanese scientists and experts, for places to be worked were allocated [to the Japanese] in the Okha Region in checkerboard pattern. After each group of four, the Soviets had a place of their own and sank their mines as near as possible to the Japanese, thus making few expenditures for exploration. Nevertheless the Japanese companies succeeded in extracting oil, and in the year 1936-1937 they brought to the surface about 200,000 tons of petroleum, slowly increasing their output. They also constructed pipelines, ports and other transport installations. From 1939, the Soviet began to apply various methods in order to rid themselves of the Japanese, when the general exploration work had already been completed by the latter. Through workers' strikes, and various hindrances in transport and deliveries, they forced the Japanese to give up their oil concessions. An attempt was made at the time to transfer the concession to the US firm of Sinclair, even before it had been granted to the Japanese, but apparently without success. Perhaps it was only a political trick in order to extort from the Japanese more favorable conditions. The Japanese concession functioned until 26 February 1942 when all the property of the Japanese companies was confiscated and passed into the hands of the commissariat for foreign holdings. However, after 1945, the concession became part of the Far Eastern Petroleum Trust.

155. We should like to point out that on 11 August 1939, under the pressure of strikes, the Soviets compelled the Japanese to sign a new agreement in Moscow, but the operations carried on after this were very indifferent; no new explorations for petroleum were undertaken, nor were the technical processes expanded; on the Soviet side of the checkerboard of concessions, intensive oil extraction continued and in 1940 it reached 750,000 tons according to some sources, and even 900,000 tons according to others. The latter figure, however, must be regarded as the total extraction of the Soviets and Japanese.

156. For the season of 1946, it was hoped to bring the extraction of oil in northern Sakhalin up to the 1,500,000-ton mark, providing that the Soviet plans could be carried out. Indeed, the field of exploration was expanded, drilling began in the lower strata, and the methods of extraction improved. These methods are still far behind, especially in comparison with the US. However, frequent accidents, such as fires, often destroy considerable quantities of crude oil. The storage of oil above the ground is bound to lead to destruction, although the construction of oil storage depots requires great expenditures. It is impossible to estimate how much oil is destroyed through the use of such an old method. During the

* Trudy Inst. Merzlovedeniya [Works of the Institute for Ice-bound Soils], vol 3. p 48. Article by Enenshtein and his work on the investigation of the Tolba River, in the Yakut region.

war of 1942-1945, Moscow sought advice from the American embassy in this matter, but it was impossible to accomplish anything, because the method of storing oil in open vats on the surface, in the vicinity of derricks, is the basic reason for losses and fires, which sometimes destroy huge quantities of crude oil.

157. Oil from Sakhalin is delivered by the local railroad and oil pipelines to the port of Mokhaleve on the shore of **Baikal** ay, from where it is transported to **Nikolaevsk** on the Amur and further by water to Komsomolsk and Khabarovsk, where there are petroleum refineries. **Official** information indicates that petroleum extraction in 1946-48 increased to 1,000,000 tons, i.e., far from the planned quantity mentioned above. The question of oil is a painful subject for the Soviet Far East, because on it depends the supply of the numerically large war fleet, aviation, motor and tractor stations, etc.--not to mention motor transport in the Far East.

158. Oil deposits have been found also on Kamchatka near the river, Bogachevka (Polana), and in Yempolka in northern Kamchatka. The oil situation is the most sensitive point in Soviet defense, because the center of extraction, Okha, is situated in easternmost Sakhalin; consequently, it is under a constant threat, while deliveries which require 4 to 5 months are too difficult, in view of the suspension of navigation over the Amur in the winter.

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