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邦領カラフト地質大要。

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PRELIMINARY NOTES ON THE GEOLOGY OF JAPANESE SAKHALIN.*

BY

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The island of Sakhalin, which lies to the north of the larger island Hokkaidō, is about 900 km. in length but less than 160 in the greatest width. The following brief note was written principally after my own observations in 1906 and 1907, and after the knowledge gained by the geologists, Mr. KAWASAKI and Mr. KATAYAMA, and by the two young students of the Imperial University of Tōkyō, Messrs. SHIMOTOMAI and MURATA.

The general report, (147 pages, in Japanese), on the mineral resources of Sakhalin,† written in 1907 by KAWASAKI, Chief Geologist to the Japanese Civil Administration of the island, contains a geological map compiled by him, a general topographical and geological sketch, and also his observations on the northern half. Besides; this work includes observations made by KATAYAMA in the south, and my own on the greater part of the boundary line of the 50th. Parallel and on the river Poronai; also numerous maps, profiles, views, and so forth.

**It is to be remembered that where, in this paper, the word "Sakhalin" occurs, it means only that part of the island which belongs to Japan, while the expression "Island of Sakhalin" is used for its whole. In the present paper, the transliteration of place-names was made as exact as possible, such precaution being made, however, not to render them so scientific as to appear foreign-sounding. The consonants are to be pronounced as in ordinary English spelling and the vowels as in Italian. This simple rule was adopted in our Romanization of Japanese and Ainu words. The Russian x is rendered by kh, and the х by y, while the sound like the German umlaut of o is also written with ö.*

† 樺太礦産調査概報

Mr. KENZŌ WADA, in his "Report of Reconnaissance of the Fisheries in Sakhalin", 1907, (184 pages, with numerous maps, diagrams, and views, all in Japanese), gave in the introductory notes, descriptions of the coast line, the sea-bottom, the meteorological conditions, and the oceanic currents of the island.

The Strait of Sōya or La Pérouse, is regarded by our zoologists as an important line, showing the presence of very different faunas on both sides of it.

The main fields of my geological observations in Sakhalin were (1) the mountains between Dubki and Chipesani, (2) the eastern coast of the island Kaibatō, also called Todojima, Todomoshiri, or Moneron Island, (3) several places on the west coast of the main island, (4) the boundary region of the 50th. Parallel, (5) the main course of the river Poronai, and (6) the coast-line from Shitka to Dubki. Those parts of Sakhalin, for which I must make use of observations by other eyes, are chiefly (1) the greater part of the west coast, (2) the greater part of the coast of Aniwa bay, (3) the coast-line from Cape Shiretoko (called Jūzō-zaki after the Russo-Japanese war) to Tunnaicha, (4) the greater part of the coast-line from the river-mouth of the Poronai, round Cape Patience (Mys Terpyeniya in Russian, Shinnoshiretoko in Ainu, and Kataokazaki again in our new nomenclature) as far as Taodō on the east coast, besides the inland routes taken by KATAYAMA or KAWASAKI'S parties. These routes are (1) on the Tokuso mountain in the North-eastern Mountain-land,* (2) on the river Nokoro (whose watercourse was actually found to be a very short one, with its source far to the south of the 50th. Parallel), (3) on the rivers Khoi and Nayashi, (4) on the rivers Esturu and Shiruturu, (5) on the rivers Naibuchi and Tomanai, (6) on the Uriu river on Aniwa bay, besides in other places.

I must here express my most cordial thanks to Mr. KUMAGAYA of the Civil Administration and to Mr. ŌSHIMA of the Boundary Commission for rendering me many travelling facilities, but the name of the old savant of St. Petersburg, the Academician, Mr. FREDERICK BOGDANOVITCH SCHMIDT, must be specially mentioned. He was in the island of Sakhalin about nine months altogether in 1860-61, and visited several places in this land. His companion, GLEHN, was there about twenty months in 1860-62. They brought to Europe a good collection of fossils, mostly Tertiary, which Mr. SCHMIDT kindly allowed me, during my stay in St. Petersburg of a month and a half, to compare with similar fossils in my collection from Hokkaidō and with recent shells from northern seas, preserved in the zoological museum of the Academy of Sciences in the town. His list of preliminary determination of the Tertiary fossils from the island of Sakhalin, then not

* See p. 4.

yet published, was revised at the same time ; and this little study of fauna made the real beginning of my researches on the geology of that island. I very much regret that I have not yet found occasion to visit the very rich fossil locality of Mgatch, lying to the north of Alexandrofsk, which furnished him with the greater part of his Tertiary Mollusks.

With regard to the geology of the island of Sakhalin in general, very little has been published, before the appearance of KAWASAKI'S work. In European languages, SCHMIDT'S descriptions of the Cretaceous fossils from Cape de la Jonquière near Alexandrofsk, the general report of travels by SCHMIDT and GLEHN, and BATSEVITCH'S "Materials for the Study of the Amur region," in Russian, may be mentioned as important. But the designation of rocks by SCHMIDT and GLEHN sometimes led SUESS to misunderstandings about the geological structure of the island, in his "Antlitz der Erde," in which he gives a list of works connected with the island.

I. Topographical Subdivision of the Island of Sakhalin.

Sakhalin consists of two longitudinal mountain ranges, making the outer and inner zones of sedimentary rocks, separated from each other by the Median line of Depression, as was already recognized by KAWASAKI in his manuscript report for the year 1905. There is only one dependent island of large size, called Kaibatō, and the coast of the main island is almost free from islets and large rocks. The Kaihyōtō (Azarashijima, or Robben Island) is a little islet of great importance, lying among the series of rocks extending from Cape Patience far to the south. It is a breeding place for the sea mammals. The well-known Danger Reef (Kamen Opasnoti) lying off Cape Notoro (Cape Crillon, also called Kondōzaki after the war) is a little mass of eruptive rock, measuring about 7 meters in height, 7 in width, and 30 in length. Flat reefs and submarine shelves are however of common occurrence round the coast.

The Median Depression is formed by the valleys of the Susuya and Takoi rivers on the south, and of the Poronai* and Tymy rivers on the north, and includes broad plains, which on both sides of the Poronai river, assume the character of tundras. This depression formed and still forms a part of the chief way leading from Alexandrofsk over low mountains down to the valley of Tymy, and further passing over to the town of Korsakoff. On the south, the Russians succeeded in improving the primitive Ainu track, which naturally proceeded on that beaten by bears. But

* This river is also called "Plyi" in Glehn's report, in *Beiträge zur Kenntniss des Russischen Reiches*, &c. 1868. I heard the name "Sangeshtū" used by the Oroko.

the road on the west side of the Poronai river has long been abandoned, and now loaded horses find pains next to death in passing the numerous and extensive tundras on the way. It is very remarkable to find that water is still very little utilized in the inland communication of the island.

The Outer Zone, or the eastern side of the depression, shows extensive regions of Palæozoic rocks and Crystalline Schists, with less extensive Tertiaries and Cretaceous, besides Eruptive Rocks. This zone is formed by the Northeastern Mountain-land extending on the east of the Poronai river, and the Susuya Mountains lying between Cape Shiretoko and Dubki. There we find a region with the lakes, Tunnaicha, Chipesani, and so forth, which in the opinion of KAWASAKI, may represent a minor zone of depression, corresponding to the region ending at Cape Patience, and carrying the lakes, Solenuiya and others, on the peninsula.

About the northern, that is to say, the Russian part of Sakhalin, our observations are restricted to the post-road from Alexandrofsk, across the low mountains with wide valleys on the west side of the Tymi river, down to Derbenskoe, and further southward to Grodekovo, lying almost on the line of the 50th. Parallel. There we must follow the "Sakhalinski Kalendari", for the year 1898 and regard the Western Range as assuming a plateau-like character on the extreme north, where GLEHN mentions a ridge of about 2000 ft. in height, projecting out towards the northern extremity of the Sakhalin Island. He points to the occurrence of only four exposures of rock (fossil-less sandstone) to the north of Oidktö; in that region there are usually found wide tundras along the coast. A remarkable contrast of the river Tymi with the Poronai is that the valley of the former is more narrow and is covered with woods and grasses, nowhere showing the nature of the tundras. The east side of the Tymi has not yet been described, but it is no doubt a part of the Northeastern Mountain-land.

The Inner Zone, or the west side of the Median Depression, consists essentially of the Cretaceous, Tertiary, and Volcanic rocks; but the Older Eruptives there are also of importance.

II. General Geology.

The tri-zonal structure of Sakhalin, which has just been mentioned, is at once recognized, by looking at any one of the now-existing maps of the island, however inaccurate they may be in degree. On the "The Guide for Immigrants to Sakhalin," 1906, published in Japanese by our Civil Administration, a map with well revised place-names was given. The great unedited map by the famous

Japanese explorer MATSUURA contains a great many names well transliterated into the Japanese *kana* (syllabic signs); the outlines, however are naturally wrong. Just the reverse is found in our charts, published by the Hydrographic Office. The coast-line to the north of Cape Patience is very wrong in almost all maps. In order to trace the principal geotectonic lines of Sakhalin, one must first look at the Geological Map of Hokkaidō, prepared by my joint work principally with Messrs. T. ISHIKAWA and S. YOKOYAMA. One will very easily find the striking similarity of rocks and fossils collected in these two islands. The north-south line is very important in the Island of Sakhalin, which is meridionally elongated, with its narrowest portion on about 48° , and a big depression on the east, forming Patience bay (called after the war "Shichirō-wan") or the broken part of the outer zone of sedimentary rocks.

But the principal difficulty in the geological structure is to trace the southern prolongation of the Median Depression. The Cretaceous terrains on the west side of the axis of old rocks in Hokkaidō are similar to those on the west side of the Depression in Sakhalin. Therefore the Median Depression of the former has no equivalent in the latter.

The occurrence of Cretaceous fossils on the east coast, towards the north of Cape Patience, is of special interest, since Hokkaidō also has the same on its far eastern part.

The island of Kaibatō, lying on the northern continuation of a line joining Rishiri and other volcanoes in Hokkaidō, must form with them a single zone of volcanic eruption, though there is no regular volcanic cone on the Kaibatō.

The Kaihyōtō, whose name is always heard when speaking about the fisheries in Sakhalin, is geologically a little piece of land, detached from the region of Cape Patience, just like smaller rocks in its vicinity.

The strike of many coal-seams and generally of various sedimentary strata is very often either exactly or nearly north to south. Also many large rivers show the greater part of their watercourse meridional. Striking examples are found in Pilevo, Agnevo, Khoi, Shitka, Nitui, Makunkotan, Chikaporonai, Naibuchi, Rūtaka and others, not to mention particularly the main rivers on the Median Depression.

The oldest geological formation in Sakhalin consists of **Crystalline Schists**, which compose the whole northern part of the Susuya Mountains and a little portion of the Northeastern Mountain-land. They are an alternation of gray and black sericite-schists, with various green schists; among the essential components of the latter we find pyroxene, hornblende, and chlorite. A gray, dirty-looking

quartzite is also found there. A black, minute-scaly biotite-schist is observed on some places on the sea-coast between Dubki and Ochopokka ; a gabbro-diorite is also found there associated with the schists. There are, however, remarkably wanting the piedmontite-schist and spotted schists, which are characteristic to a similar formation in the mountains to the north-west of Tōkyō. We can not tell at present, whether these schists in Sakhalin represent one or other of Mikabu and Sambagawa Series of this region. Moreover the occurrence of diabase-tuff amongst the schists in Sakhalin raises the question as to whether it makes a concrete part of the schistose series or not. The character of stratification can only be observed in the Susuya Mountains, where the strikes are most frequently meridional.

The next older rocks are the ordinary **Palaeozoic** Sediments, such as sandstone, phyllite, clayslate, quartzite (both red and gray), diabase-tuff (red and green), and limestone, the last of which is sometimes interbedded in the tuff. The gray quartzite is sometimes so very irregularly cracked, as to look brecciated, for instance on the northern shore of the larger basin of the Chipesani lake. No fossils have yet been found in the Palaeozoic, except indistinct Radiolarian remains in some red quartzites. Most of the exposures show distortions, but where the stratification is rather regular as on a very limited portion of the 50th. Parallel, we find the meridional strike prevailing.

Eruptions of diabase in the form of masses and interstratified tuffs are of common occurrence in the Palaeozoic. But the hornblende-granite, which changed the strata by contact action, must be specially mentioned. The principal locality of the granite is at Cape Shiretoko and its vicinity, where KATAYAMA found a biotite-hornfels on the contact. On the boundary region of the 50th. Parallel, the granite appears as boulders in a river, but the extent of contact metamorphism is not very limited. There is a very well cleaved, compact biotite-hornfels, and a green, massive, and compact amphibolite. The former is no doubt derived from the clayslate and the latter from a tuff, although no gradual transitions from those sediments are observed in the field. KAWASAKI also found a hornfels on the mountain Tokuso in the Northeastern Mountain-land. Large boulders of granite, found on the Kaihyōtō and near Cape Patience and many other places on the coasts of Sakhalin, indicate a rather wide distribution of this rock. Pebbles of quartz-diorite and a contact slate, with characteristic hexagonal trillings of cordierite, as those abundantly found at several places in Japan, have been met with on the river-bed of the Naibuchi.

The **Mesozoic** rocks, whose total area is next to that of the Tertiaries, show their principal development in a broad zone on the west side of the Median

Depression. The oldest known and the best explored locality of the Cretaceous fossils is that of Cape de la Jonquière near Alexandrofsk. The very rich locality on the lower course of the Naibuchi river, called "Petrefactenschlucht" by LOPATIN, who lost all his collections from there on his boat turning upside down, was studied particularly for the coal-seams found there in the Tertiary. There are several other places in Sakhalin, where more or fewer specimens of Cretaceous fossils have been already found ; as for instance at the Gilyak hamlet of Pilevo and at Wenchishi, both on the west coast, on the rivers Khoi, Shiruturu, and Makunkotan, besides at Wäre and Otasan on the coast of Patience Bay, Takinosawa on the pass from Vladimirovka (the future seat of the local government) to Mauka across the Western Range, and Motsnai, Tomarionnai, &c. on the west coast of Aniwa bay. Besides, SCHMIDT states the occurrence at Manue on the coast of Patience bay, also at Cape Patience, at Cape Bellingshausen, and near Rymnik. However I only found finely broken shells of *Inoceramus* in colossal amount, enclosed in a black shale, at about 8 km. to the north of Narumi on the east coast. The Mesozoic region near Tōni, observed by KATAYAMA, affords no fossil.

The *Cretaceous* rocks, which very often show a meridional strike, and carry tuffaceous admixtures as the Tertiary sediments do, are sandstones (in part glauconitic, as on the river Naibuchi and on the west of Takinosawa), besides shales (gray or dark in colour, and sometimes hard as on the Khandasa river, and usually carrying marly nodules, which may grow together in layers), and conglomerates. The Cretaceous conglomerates must not be confounded with those on the boundary of the coal-bearing Tertiary and the Cretaceous, as observed at Pilevo and on the Khandasa river. A peculiar light-gray marl, on the lower course of the Naibuchi and on the Khandasa too, is without any fossil. Well preserved fossils are to be sought for in marly nodules in the shale, but less common in the shale itself or in sandstone. It is usually very difficult to draw a line of boundary between the Cretaceous and Tertiaries, which are always found side by side, and whose petrographical characters are in most cases perfectly identical. Only a peculiar white-spotted appearance after weathering of a gray sandstone in the Cretaceous, as on the Khandasa and Pilevo rivers, is to be noted.

The principal fossils are *Nucula*, *Cucullaea*, *Inoceramus*, *Phylloceras*, *Puzosia*, *Pachydiscus*, *Gaudryceras*, *Hamites*, *Trochocyathus*, *Cidaris*, *Ananchytinarum*, &c.

The horizon represented in the Cretaceous of Sakhalin will correspond to the uppermost parts of the same formation in Hokkaidō. A regular meridional strike is often observed on the river Khandasa (where no fossils were collected), on the

Naibuchi river, and other places.

The *Jurassic* has only been observed in the Russian part of the island ; Mr. FREDERICK KLEÏE, in Alexandrofsk, who lived there for many years, showed me a letter from Professor E. FRAAS (dated Feb. 22, 1904) stating that the fossils in marly nodules from Andree-Iwanofskoe near Rykoff may be identical with the *Astarte depressa* from the Lower Oxfordian of North America.

The **Tertiary** rocks occupy the largest area in the island, and are especially well developed in the Western Range, where various beds with characteristic fossils are met with. The rocks are sandstones, which are sometimes siliceous, sometimes tufaceous, sometimes glauconitic and sometimes banded with lighter and darker coloured portions, and often broken in plates ; shales, which are sometimes very dark, but sometimes tufaceous with gray or almost white colour, and in many cases contain marly nodules with or without enclosed fossils, and various conglomerates ; besides tuffs of different colours, white, gray, green, and so forth, as well as agglomerates, both of which are sometimes as extensively developed as in some parts of Hokkaidō. Agglomerates with associated tuffs are observed on the east coast, about 16 km. to the south of Narumi, near Wāre, at and near Cape Notoro, also near Ushoro on the west coast. The diatom-earth, attaining in Hokkaidō a great thickness of 12 meters, is not found in Sakhalin.

Although the relative position of various fossiliferous beds in the Tertiaries has not yet been made out, the plant-bed with several broad leaves and one or two kinds of *Sequoia* leaves associated with coal-seams in the Naibuchi and Serutonai coal fields and on the river Khandasa on the boundary region, can directly be compared with that in Hokkaidō, which was also formerly believed to be Miocene. The coals of Sakhalin, which are often more than 3 meters in thickness, resemble in part those of the Ikushumbets mine in Ishikari, Hokkaidō. Besides, the pale-gray tufaceous sandstone, associated with many coals in Sakhalin, strikingly resembles that in several coal-fields in Hokkaidō, as those of Ikushumbets and Poronai. The mineral resin, which is observed in sands of sea-beaches on the coast of Patience bay and other places, seems to have been derived from the coal by its disintegration. Silicified wood is found not only in coal-fields but also in several other places.

In the Tertiaries of Sakhalin, the following beds with animal fossils are distinguished : --

- (1.) Shale with calcite pseudomorphs resembling thinolite.

(2.) Gray sandstone with *Pecten Peckhami* (Merei), and gray tufaceous shale with small shells of the same species (Kushunnai).

(3.) Gray shale with *Thyrasia bisecta* (Shiraraka and Tomarionnai), and with *Echinarachnius* sp. (Takinosawa); and greenish-gray shale with *Tellina* sp. (Mauka and environs).

(4.) Gray tufaceous shale ("Kushunkotan Shale") with an inflated form of *Yoldia*, showing a very wide distribution, as for instance at Korsakoff and its vicinity.

(5.) Gray sandstone with several species of Mollusks (Wenruesan, Porotomari, etc. near Ushoro; and other places).

(6.) Dark-gray marl with sponge remains (Peshuturu).

(7.) Soft gray sandstone with *Mya crassa* (the lower course of the Naibuchi river), and similar sandstone with large shells of a large-eared species of *Pecten* (the same locality and Peshuturu).

KAWASAKI endeavoured to subdivide the Tertiaries of Sakhalin, without taking the difference of fossil contents much in consideration, (see his report, p. 16-17).

Whether the above enumerated beds are really independent of one another can not yet be definitely answered; but we must remember that many fossil forms are also met with in Hokkaidō. Thus, *Thyrasia bisecta* occurs at Mōrai in Ishikari province, and other places; *Echinarachnius* at Kanikarushi in Hidaka, the inflated *Yoldia* in the oil-field of Mōrai, and at Wakkanai in Kitami; *Mya crassa* at Penanrubeshbe in Tokachi, and *Pecten Peckhami* at Yūdō in the same province. The numerous Molluscan species of Wenruesan and other places will correspond to those in the shell bed of Piratoriushnai in Hidaka.

The **Quaternary rocks** in Sakhalin are clays, sands, gravels, and peat. The young deposits composing the coast terraces sometimes attain a great thickness of more than 60 meters. Gold placers were discovered mostly in the valleys of Palæozoic regions. Volcanic detritus may be met with on the slopes of the conical mountains of Ushoro, but it has never yet been actually observed by us, anywhere in the island. The deposits of sea-terraces, which usually level the irregular surface of underlying hard rocks, sometimes lie upon the well-shaved horizontal face of rocks, as at Ochopokka and other places. This fact is of special interest in connection with the shift of sea-level in past periods, when we remember the extensive development of submarine shelves on the present sea-coast, especially in the regions of Tertiary rocks.

The formation of thick peat underneath the still growing mosses and lichens

of the tundras is best studied at Khandasa on the right bank of the Poronai river, far to the south of the opening of the river Khandasa. There the dried-up mosses at an eroded margin of a tundra make a transition into a brown layer of the same stuff, about half a meter in thickness. Below this layer there is a dark-brown peat more than 6 meters in thickness, resting upon a light-gray bed of clay. Vast masses of peat, detached from such a cliff in flood, now lie upon sands and pebbles of the river-bed, and look like small grass-thatched roofs of hut, when first observed from a good distance by a new visitor.

Thin layers of peat are also found on heaths, which extend on low wet grounds as at several places on the 50th. Parallel, on the south of Nayoro on the coast of Patience bay, and to the south of Kushunnai on the west coast, also on the plain of Mitslyofka on the Susuya river, and so forth.

The shell-mound of Soloviyofka near Korsakoff, which consists of recent shells of *Ostrea* sp., *Macra sachalinensis*, and other forms, lies chiefly on a terrace, about 35 meters above the sea level, at a direct distance of less than half a kilometer from the coast. This locality, which remained almost unexplored, has this year rewarded Professor S. TSUBOI with numerous finds of archæological interest.

Of the Older Eruptive Rocks, granite (hornblende-granitite) has been already mentioned in connection with the contact metamorphism in the Palæozoic regions, where ordinary diabase is also extensive.

Various facies of granitoid diabase are observed near Shiranushi, and on the west coast of the boundary region of the 50th. Parallel. There are granular, aphanitic, as well as porphyritic varieties of the same rock. Olivine is sometimes observed in this eruptive. Columnar joint, with the axis perpendicular to the face of contact with the underlying sedimentary rock, are observed in the similar diabase of Pilevo, where the rock appears like an intrusive sheet. The same, forming a small rock in the sea of Ambets, is again irregularly cracked with plane faces of fracture, beautifully covered with minute scales of dark-brown mica. The contact of the rock with a dark shale on the south of Pilevo seems to have exerted no influence in the petrographical characters of either one of the rocks.

But the occurrence of gabbro is very limited.

Ordinary diorite with its porphyritic modifications are met with on the 50th. Parallel, though never found in great extent.

Volcanic Rocks are abundant in Sakhalin, but not of such great importance as those in Hokkaidō. No active craters are known to exist. There are only two or more conical mounts* on the otherwise quite low mountains of Ushoro, whose

* The well-known, very conspicuous cone of Kitoushi-nupuri (or Kitoushi-pal) on the west

geology was only guessed at by the nature of pebbles in a river descending from them, and the actual presence of andesite exposures at Ushoro and its environs.

The volcanic rocks of Sakhalin are mostly pyroxene-andesite, sometimes making a transition into basalt. The andesite often shows columnar and other joints. Some specimens present an old aspect, as at Wäre. Basalt occurs at Otekoro, Notasam, the island Kaibatō, and other places. Liparite, which occupies in Hokkaidō a very extensive area, especially round the mountain-mass of Optateshke, is here almost restricted to the region of Shiraraka, where a reddish-gray compact specimen with a fluidal structure is met with. A white silicified, decomposed liparite occurs at Ruionaibo near the same place.

The diabasic rock, which turned the coal of the Serutonai coal-field into natural coke, resembles that found in the Chiku-Hō coal-field in Kyūshū under the same condition.

Pretty pebbles of white chalcedony, found near Nayoro and other places in the main land, and at many localities in Kaibatō, attract the eyes of every tourist, and are derived from the cavities in lavas and agglomerates of usually andesitic nature.

The vast deposit of pumice, so widely distributed in Hokkaidō and also on Kunashiri and other islands belonging to it, has never yet been observed in Sakhalin.

As regards the distribution of volcanic rocks, we may only state that their principal districts are in the Western Range, not only on its west coast, but also at several places between Nayoro and Manue on the east. On the river Poronai, hills of andesite and agglomerate are found not far below Sakai (formerly probably known by the name "Poronai" after the river itself), that is the place where the 2nd. Astronomical Point of the 50th. Parallel is found on this river. On the coast of the Okhotsk sea, similar rocks were observed about 16 km. to the south of Narumi.

The form of the andesite mountain, along the sea-coast of the region of Poronaipo on Patience bay, shows its formation as a dyke.

III. Geological Consideration of Topographical Features of Different Subdivisions of Sakhalin.

Now we proceed to the characteristics of different parts of Sakhalin, commencing with the Median Depression of fundamental importance. On its northern part

coast to the north of Pilevo, is of sandstone according to Schmidt. The Tusso mountain on the coast of Patience bay is of volcanic rocks, and looks conical only in one direction.

I observed the whole length of the Japanese portion of the Poronai river from a boat. On the south, both the Susuya and Takoi rivers were only visited within a small limit.

The Median Depression.

Before 1906, we had no reliable map of the river Poronai accessible, and the place-names on it were often very carelessly copied from one map into another. It is felt that a certain knowledge of at least three different languages, Ainu, Orocco, and Gilyak is there necessary, all of which occur in the names. Such a complexity of nomenclature is found in no other place in Sakhalin. This great river has large branches only on the western side. On the eastern side, Muigö and Bolmöksha are worth mentioning. Many tributaries show narrow mouths, compared with their width a little above them. The main river is about 230 meters wide at the mouth and about 45 on the 50th. Parallel. The river is navigable up to Poroto, with a small steamer of about 4½ ft. draught. The main course shows a great meandering, which produced several crescent-shaped lakes, by drift-wood choking up one of the canals, into which the river is often split up. The hugest heap of this wood is found about 8 km. direct distance from the 2nd. Astronomical Point. It was a good piece of labour to remove a part of the accumulation, measuring about 500 meters in length, by blasting the wood with picric powder. The river-bed seldom shows in the Japanese part pebbles larger than 20 cm. in diameter. Both sides of the river are flat plains, with the exception of only a few places above Bolmöksha, where the spurs of hills reach the river and end abruptly in high cliffs of volcanic rocks, sometimes more than 50 meters in height. Where the flood-water has eroded away a margin of the tundras, the formation of peat is best studied. A gray clay usually forms the basement of the peat, which attains the thickness of more than 6 meters. Otherwise the main river shows nothing of geological interest.

However, the pure forests of poplar-trees (*Populus suaveolens*), and of larches (*Larix dahurica*), the forests of *Picea ajanensis* mixed with *Abies sachalinensis*, and those of birches (*Betula alba* and *Ermanni*) attract the attention of all observers, especially in Autumn, when the leaves assume the beautiful colours peculiar to themselves. The luxuriant growth of such and other trees is by no means welcome to surveyors, concealing nearly everything at a short distance. In good weather one can enjoy the distant sceneries of the gigantic mountain Ninkutnupuri or Ambarmait (about 1200 meters high, according to KAWASAKI who ascended it), together with elevations connected with it. The lower

elevations on the other side of the river, that is to say, along the eastern sea-coast, can be seen only on the lower course of the river.

The so-called Tundra* of the plain of Poronai is a flat land, occupying its greater part and covered with lichens (*Cladonia*, *Stereocaulon*, etc.) and mosses (*Sphagnum*, *Polytrichum*, etc.), besides shrubs such as *Ledum palustre*, *Vaccinium hirtum*, *Betula nana*, and so forth, also a remarkably crippled form of *Larix dahurica*. The tundra is more or less wet with the brown water of bogs, on which the pedestrian sinks into a depth of at least one third of a meter. Close to the side of flowing water, however, drainage is complete, and no character of tundra is there observable, and we find forests of coniferous as well as broad-leaf trees. The ground was frozen in the very height of summer below the depth of more than one meter, at a tundra just on the west side of Sakai, and also on the eastern bank of the Poronai, about 8 km. (direct distance) below Sakai. In the midst of the tundras, there are often found heaths where the ground is more dry. Among the low mountains and in valleys, also on the sides of the tundras, there are extensive heaths.

The large lagoon-lake of Taraika on the north coast of Patience bay has a long spit, across which a little boat may be dragged by those, who want to pass from the bay by the shortest distance into the lake, and then over the narrow land on the west side up to the Tarankotan river.

The southern part of the Median Depression, occupied by the plains with the rivers Susuya and Takoi, shows the character of vegetation different from that on the Poronai, there being observed no tundra, though heaths are found at Mitslyofka and other places. The whole region is a plain, with low terrace-lands lining some of the hills, but without high cliffs of rock, extending right down to the river side. Cultivation is going on in the former Russian settlements, which makes a great contrast with the wet and sterile character of the main part of the Poronai plain. The principal lands selected to introduce immigrants from Japan are mostly found on the lower course of the rivers, Susuya, Rūtaka, and Naibuchi; and on the low plateau to the west of the Tunnaicha lake.

No marked feature revealing any fault character of the Median Depression has been yet recognized. The presence of volcanic rocks just on the bank of the Poronai river is however remarkable.

The two bays, Patience and Aniwa, may here be treated in connection with the Median Depression on land. These are the only two large bays in Sakhalin,

* We possess no particular Japanese word for such a sort of land. The Russians call it "Tundra," which word was introduced to us, after our making acquaintance with it after the war. This word is naturally often corrupted by the Japanese into *Tsun-do-ra*!

with their terminations formed by the Capes Patience, Notoro, and Shiretoko. There are no other well marked promontories in Sakhalin. The existence of the three capes and the narrow form of land, measuring only about 30 km. from Manue to Kushunnai on about 48° , are very important when taken in connection with the oceanic currents, meteorological conditions, and the distribution of marine plants and animals.

Patience bay is very shallow (K. WADA, p. 12-13). When a line is drawn between Cape Patience and Cape Tōni, the breadth of the sea enclosed on the west side of it is 100 sea-miles in maximum, but the depth rarely exceeds 50 fathoms. Patience bay is particularly shallow, showing a flat sandy bottom.

On the other side of the line, the real sea-bottom is found at about 15 sea miles to the east of Tōni, showing there a depth of 125-160 fathoms.

Aniwa bay is also shallow (K. WADA, p. 13), the depth being generally about 25 fathoms on the inside of the line from Cape Notoro to Cape Shiretoko. Soundings of 50 fathoms or more were rarely made there.

The Western Range.

The general topographical features of this part of Sakhalin, whose watershed lies a little to the west of the real median line, shows a marked contrast with the east side of the Median Depression.

Here we find a great development of the Tertiaries and the Cretaceous, with a less extensive one of Volcanic and other Eruptive Rocks. The Cretaceous forms high mountains, among which the Ninkutnupuri shows lofty peaks with snow remaining in summer in some parts of narrow valleys.

On the east, however, we find particularly rugged sceneries of Palæozoic rocks with subordinate Crystalline Schists, besides the Tertiaries, the Mesozoic, and Eruptive rocks, which are all more limited in area. The Volcanic Rocks are, however, not wanting in the east.

Now look at the west coast of the Western Range (K. WADA, p. 2-5 and 13), which consists essentially of the Tertiaries, in which diabase, andesite and other eruptives appear in various forms. Turning round Cape Notoro from Aniwa bay, we pass over to the coast of the Japan sea, measuring more than 500 km. up to Ambets on the boundary. Our Chart published by the Hydrographic Office puts the cape at $45^{\circ} 54'$ N. L. The general straightness of the coast-line is remarkable in Sakhalin, especially to the north of Cape Patience.

Along the west coast, a depth of 100 fathoms is often observed even at a distance of 10 miles from the beach line; that of 10 fathoms is found at about one

mile. At a place 50 miles to the west of Mauka, Mr. NAKAMURA, one of the assistants of Mr. K. WADA, found a line 190 fathoms long not reaching the bottom. From Kushunnai to Raichishka, a sounding of 20 fathoms is made beyond 5 miles off the coast. At Ushoro, water is deeper, showing 50 fathoms at the same distance, a gradual shallowing being however observed towards the north, as we proceed on into the Mamiya strait (Strait of Tartary), which is only about 5 miles wide and allows a free passage on sledges across the frozen sea in winter.

Between blunt capes, mostly consisting of andesites and other eruptive rocks, there are slight concavities of coast line which are only used in summer seasons, when the sea is calm with easterly winds prevailing. From the later autumn to the next spring, rough westerly winds sweeping over the Asiatic coast, leave no shelter to ships on that coast. From Cape Notoro to Tokombo (about 90 km.) there is no plain on the bottom of coast-hills, and there swift currents and numerous series of reefs hinder the progress of the fisheries. From Tokombo to Cape Chiikai (about 120 km.) the generally terrace-shaped character of the coast land is conspicuous. The only exception is the sandy plain with dunes, found at Notoro (not to be confounded with Cape Notoro on the south), which is said to be slowly decreasing, on its whole length of about 20 km. On the terrace coast, there are level grounds, from about 10 meters to more than 100 in width, extending along the beach. There are again more or less level lands on the back, 6 to 50 meters in height; and equally flat shelves in front, covered by water of 2 or 3 ft. in depth. These submarine shelves of rock, which are found not only on this part of the sea-coast but also at many other places of Sakhalin, where the Tertiary rocks are prevailing on the coast, is particularly well developed on a stretch of about 72 km. from Tokombo to Tokotan. Their width varies from about 30 to 300 meters. The depth of water over them is 3 to 5 ft. at their margin, where it is deepest, and beyond which we find a sounding of 3 to 5 fathoms. From Tokotan to Kushunnai, shelves are found here and there; on the north of Ushoro, they lie deeper in the water, which is one fathom in depth close to the beach line.

The terrace coast shows the continuation of valleys cutting the shelves in the form of broad clefts, which admit at Mauka entrance to small steamers of about 200 to 300 tons. The most important roads for ships there are Tokombo, Okō, Ohotomari, Mauka (the most important and now well populated town on the west coast), Rakumaka, Notasam, and others.

From Chiikai to Kushunnai (about 55 km.) topography of the coast-line is very different from that of the above mentioned region. The hill coming more close to the sea-coast, often shows precipices of about 30 meters in height,

descending directly into the sea water. There the principal roads are Otekkoro, Tomarioro, Orontomari, Epekeenrun, Shiraroro, and others, of which Tomarioro is of some importance.

The region of Kushunnai shows broad and flat sandy shores.

Between Paikoshakushi and Ebishi (about 20 km.), hilly lands come close to the sea water.

To the north of Raichishka, where a large lagoon of the same name is found, we observed a mountain of andesite, on which stand the conical mounts of Ichara, Kotanturu, and so forth. There Cape Ushoro shows steep cliffs of rock with big boulders underneath, which is a feature not commonly observed on the west coast.

On the stretch of 160 km. from Ushoro to Ambets on the 50th. Parallel, the coast-line shows very few slight concavities. They are Horokeshi, Omuto, Itonai, and Nayashi. These places show shallow waters, and with the exception of Nayashi, are lined with steep cliffs with narrow grounds below.

Now the west coast of Aniwa bay (K. WADA, p. 6). There are Tertiary rocks, besides Volcanic Rocks and the Cretaceous of a limited extent. There are numerous high rock-cliffs, chiefly of andesite, descending directly into the sea water. A bay on the south of Cape Chishiya forms the only road for smaller ships on the whole extent of the coast, which measures 120 km. from Notoro to the opening of the Rūtaka river.

We now pass over toward the north of Korsakoff, and make observations from Dubki, along the east coast of Sakhalin, up to Nayoro, (K. WAKA, p. 9).

From Dubki to Shiraraka, there is a sandy coast with many lagoon-lakes, showing a very broad plain on the mouth of the Naibuchi river. There are many huge dunes on this plain, where travellers wonder at the abundance of dwarf pines (*Punis pumila*), which are to be seldom observed on the other coasts of Sakhalin. All the lagoon-lakes are nothing but the bends of rivers, which are, on both east and west coasts of the Western Range, usually directed towards the north. The sea-bottom shows a gentle slope, the reefs are not there abundant, and only at Wāre we find a poor shelter for boats.

To the north of Shiraraka, especially in the region between Wāre and Makunkotan, the mountains form steep precipices directly descending into the deep sea, where numerous reefs are also observed. The well-known Tusso mountain belongs to this part of the sea-coast. There are also terrace lands. Between Shiraraka and Poronaipo, the sea-bottom is irregular and carries many reefs on it. Between Wāre and Poronaipo there are submarine shelves.

To the north of Makunkotan, the coast-line allows free passage to observers,

just as on the south of Shiraraka, the beach-sand being broad especially on the river-mouths ; from Poronaipo to Nayoro, the sea bottom is flat and sandy. The rugged mountain-range along the sea-coast of the region of Poronaipo, stands in front of low mountains of Tertiary rocks. This range is of such an andesite, as that occupying a large area in the region of Makunkotan, and found also at many other places on the coast-line from Dubki to Nayoro, where the exposures are mostly Tertiary sediments. Liparite is founded only near Shiraraka.

The east coast of Sakhalin has in general fewer rough places for observers proceeding on foot than the west coast, although the region near Cape Shiretoko is naturally an exception.

The East Side of the Median Depression.

Beginning our observation at the region of Korsakoff (original Ainu name, "Kushunkotan") on Aniwa bay (K. WADA, p. 6), we find first of all a terrace coast, extending about 50 km. from Tretiya Padji down to Chipesani, with characteristic submarine shelves. The rocks exposed are mostly Tertiary, though at and near Chipesani, there are Palæozoic strata. Here lies the badly sheltered anchorage of Korsakoff, the present seat of local government. To the south-east of Chipesani, there is a low sandy coast with the interesting Busse lake, with oyster banks and other marine products, and said to possess an opening with water 12 ft. in depth, though this has not yet been confirmed by our observers.

Further to the south, we have the steep rocky coast of the region of Palæozoic rocks, with granite at Cape Shiretoko and its immediate vicinity, where the cliffs are very picturesque and attain about 100 meters in height. Here the principal barrier to communication is the roughness of ground, while on the north the opening of the Rūtaka river prevents an easy passage from the sea into land.

Leaving Shiretoko and passing over to the external sea (K. WADA, p. 7), the stretch of land from Shiretoko to Cape Tōni (about 80 km. long) shows several dreary sceneries of high and steep cliffs of Palæozoic rocks, either descending directly into the deep sea-water or with a narrow land below. There are many reefs in the sea-water. Less rugged is the northern part of this region, which consists of Mesozoic rocks without fossils so far discovered.

Airop bay on the west side of Tōni shows a narrow plain in front and a hill behind, and there is the best road for ships running along the east coast, especially in the principal fishing season, when the northeast wind seldom sweeps over the sea.

The immediate vicinity of Tunnaicha is a broad sandy beach.

From Tunnaicha to Ochopokka, we find a terrace coast with cliffs of Tertiary rocks, above sandy beaches with submarine shelves.

On the south of Tunnaicha, there is the large lake of the same name ; the hills on its south coast separating it from the northern basin of the Chipesani lake, which again communicates with a narrow opening to the southern or smaller one. Although the latter basin is separated from the sea by a sandy ground of slight elevation, the larger one as well as the Tunnaicha lake, and its western neighbour the Omutō, can not be simply regarded as lagoons on sandy shores. The opening of the last lake into the sea lies between Tertiary terrace-lands, while the shores of the Tunnaicha lake are hills, and not the simple eminences of Quaternary deposits. The sand of the sea-side on the east of Tunnaicha covers the Tertiary rocks of the hills.

From Ochopokka to Sakaihana, we observe the steeper side of the apparently asymmetric meridional range of the western part of the Susuya Mountains. Except on the southern region, which consists of Tertiary rocks, we find there rough sceneries mostly of crystalline schists, but partly of ordinary sediments of the Palæozoic. There are perpendicular rock-cliffs with huge boulders below, and reefs and rocks in the sea water.

Now we go over the sea directly to the north coast of Patience bay, and observe the Northeastern Mountain-land. From Nayoro to Nokoro, there is geologically speaking not much to be observed, for the whole coast is a sandy plain of the river-mouth of the Poronai. From Nokoro to Cape Patience, there are terrace-cliffs of Tertiary rocks, in which andesite occupies a small area near Yangenai. The so-called "Funakoshi" (that is an *overland* passage for a small boat!) lies on the lake Solenuiya. Here the natives, who wish to pass over from Patience bay to the outer sea, drag their boat over a land of only about 150 meters in width lying between the lake and the bay, and then row out to the sea, in order to save the time and labour of turning round Cape Patience, projecting out like the end of the elephant's *proboscis*. On the north coast of Patience Bay, we usually observe the westward bend of rivers at their opening into the sea.

The small island Kaihyōtō, or "the island of sea-dogs," as it is not very properly named, is a breeding place of the other sea-mammals. It is nothing but a little land detached from the peninsula on its north, just like a series of smaller rocks, making hindrances to navigation round the cape by a short course. The island is a very flat piece of land of about 15 meters in average height with sandy plains all round, and consists of Tertiary rocks, granite (?) being there found only as huge boulders. The whole length of the island is only about 700 meters.

The eastern sea-coast forms a gentle curve from Cape Patience up to beyond Narumi, everywhere with sandy beaches. On this part the sea is covered with mist very frequently in spring and summer ; and often at the end of August, even under a perfectly clear sky, the horizon is still found misty.

That part was geologically observed by KAWASAKI and his party, as well as by myself. Commander Y. WADA observed the presence of shale (?), making cliffs between Flat Bay and Cape Bellingshausen. KAWASAKI'S observation extends from Cape Patience to a little before the Taodō lake, which he did not observe. My route along the sea was between the mouth of the Akhmametiëff river and the andesite cliff, lying about 16 km. to the south of Narumi, and also at a place on the north side of Cape Povorotni, which I touched last year.

KAWASAKI has coloured as Cretaceous, in his geological map, the whole coast from the west side of Funakoshi just to Narumi, and SCHMIDT has mentioned the occurrence of the Cretaceous at Cape Bellingshausen and near Cape Rymnik. However that part of the region which I observed consists essentially of Tertiary, Palæozoic, and Mesozoic rocks, with andesite and agglomerate both of a limited extent.

The peninsular part ending at Cape Patience is described as a low hilly land, gradually rising up to the region of the Flat Hill and Bratkofsk. Flat Bay has a number of lakes on the back ground, which is extremely low. Beyond the bay, there extend low coast-hills and terraces, forming the margin of high mountains of the interior, which consist, near the 50th. Parallel, entirely of Palæozoic rocks. In the Palæozoic region, there are many peaks to be observed from a steamer running off the coast. The Tiara, which name is found in nearly all maps of Sakhalin, close to the 50°, can not be easily distinguished from the other equally high points round it, by looking at the Chart of Sakhalin or the original work of Krusenstern, who first named it.

The coast-cliffs between Cape Patience and Narumi seldom fall directly into a deep sea-water. That part of the coast still remaining unobserved can probably be easily examined by geologists going on foot along the sea-beach, and no river of great depth will be met with on his route. For this part we must now be contented mostly with our observations from the steamer Daïreïmaru, which ran last year very close to the coast line.

The swell of the sea is constantly present on the coast to the north of Cape Patience, and consequently the sandy beaches fall into the rumbling sea-water by low but abrupt slopes. Besides, almost all the rivers are said to have a very shallow opening to let fishers' boats in at the time of storms. Thus the rivers

are generally still full of fishes. Bear-tracks abound along them, where they catch fish for food, and look at unexpected human visitors with curious eyes, without running away at the first sight.

We now turn our eyes into the interior of the mountain-lands on both sides of the Median Depression. Mountains are almost everywhere covered with dense forests, and valleys and plains are grown with tall grasses. Not only this, but the abundance of fallen trees is found after heavy storms and forest fires, the latter of which are peculiarly frequent and long-lasting in Sakhalin. Trees have usually short roots and easily fall down by the pressure of wind, and this makes great obstacles to explorers pushing deep into the mountains. There are however frequently found good tracks of bears, which may easily be mistaken for those of natives. The growth of bamboos and several tendril plants, which embarrass observers in Hokkaidō, is less luxuriant in Sakhalin. What makes a great impression to travellers even from Hokkaidō, which in several respects closely resemble Sakhalin, is the great extent of forests of straightly growing larches, and a generally less variegated appearance of vegetation, when compared with that of Hokkaidō. There are many plant-forms, which we do not see in Hokkaidō, among which the medicinal plant of the family *Compositae*, known by Russians as "Remashka" and every where found in Russian settlements, may be counted.

The clouds of mosquitoes and at least four other obnoxious insects cause much suffering to poor explorers. The land is by no means actually free from poisonous snakes. I met with four or five of them in a single day, when I was going up the Akhmamietieff river on August 18th.

June, July, and August are the driest months in Sakhalin. The great heat of summer is felt only during a few hours, and in night and morning it becomes so cool that mosquitoes retreat from their daily work of persecution. But on the bank of the lower course of the Poronai and similar rivers, we find an unfortunate exception to this rule. Snow falls first toward the end of September in the mountains, and much later on the sea-coast and low regions. Snow disappears from the ground at the end of April in warmer places.

My own observations across the mountainous lands are limited to the region of the boundary line of the 50th. Parallel, and only a few other places as along the Japanese part of the Poronai river, from Korsakoff to Tunnaicha and Ochopokka, along some rivers on the western flank of the Crystalline Schist region of the Susuya mountains, and on a part of the path leading from Vladimirofka toward Mauka on the west coast. But about the typical geological profiles of different regions we have

at present not much to discuss. The thick vegetation, hiding all the inner structures of land, is one never seen in South Manchuria, where natural geological profiles are exposed in many places to travellers, who vainly seek for the shade of trees. In Sakhalin, the principal fault-lines and axes of folding are not yet known. Clefts in submarine shelves, found at Rakumaka, Mauka, Ohotomari, Asannai, Okō, and Moiretomari, have already been spoken about. They are, according to KATAYAMA, probably ditch-like depressions along prevailing fault lines of local importance, parallel to which rivers run.

Generally speaking, the mountains of Sakhalin are characterized by gently sloping, open valleys, without many high precipices on the side of rivers. Waterfalls are seldom met with, though rapids and gorges are found. Exceptions to this are found in the region of older rocks, especially in the Northeastern Mountain-land. One indeed wonders, when he first looks at the almost dried-up beds of many rivers, running across the highway leading from Korsakoff to Dubki, and then proceeds only a few kilometers up those rivers to find a wild flow of abundant cold water even in summer. The rugged sceneries on the eastern part of the 50th. Parallel is a more remarkable one. Naked peaks of rock, horns of quartzite, stone-deserts on mountain-slopes, torrents descending almost vertical cliffs more than 100 meters high, many gorges and rapids :- all these surprise observers coming new from the flat plateau-lands round Korsakoff. In the region of younger rocks, however, we must generally go to coast-cliffs to find good exposures.

Usually no topographical boundaries between different formations can be drawn. For instance, the mountains of Palæozoic contact-rocks on the 50th. Parallel are very low and flat. It gradually rises up to the region of crystalline schists on its side, while further on we find ordinary Palæozoic sediments, to which they make topographically a gradual transition. Only on the main watershed of the Northeastern Mountain-land, the above-mentioned wild sceneries begin to appear.

The Mesozoic region on the 50th. Parallel, to the west of the Poronai river, also shows high cliffs on rivers. There are certain high mountains as Aimiya, on both sides of which usually quite different conditions of atmosphere are observed.

The height of the mountains in Sakhalin are only roughly estimated in former publications. Where actual surveys were made in recent times quite a different result was presented in the numbers. On the east of the Median Depression, the height of 900 meters near Okimiyama will be taken as one of the highest elevations. On the west we have about 1100 meters on the Aimiya, about 1200 meters estimated by KAWASAKI for the Ninkutnupuri, which he ascended, and about 1000 meters estimated for Mount Spanberg etc.

No peaks in Sakhalin seem to attain the snow line. The snow, which we found remaining in summer in valleys of the Palæozoic mountains on the 50th. Parallel all melted away in the same year.

Alpine plants are found not only on ridges of high mountains, but occur also on tundras and even on sea-coasts. In Sakhalin, where plants of different zones occur together along hill-slopes and beaches, it must have been a great task for Schmidt to subdivide the zones of vegetation.

The Island of Kaibatō.

This island lies alone in the sea to the west of Moiretomari on the west coast of Sakhalin. From this place, the Ainu pass on their small boats to the island, on calm days in the proper season, to hunt sea-mammals. I myself observed only the eastern side of the island. The Kaibatō consists of andesites, agglomerates, and the Tertiary rocks, tuffs, shales, and sandstones. The eruptives are found as sheets and dykes. The coast line is everywhere rugged with reefs, and high cliffs often with waterfalls. The mountains however show gentle slopes, which are mostly grown with grasses. The sea abounds in isolated rocks, on which sea-lions are sometimes found in crowds. Hence the name Kaibatō, Todojima, and Todomoshiri, all meaning the "island of sea-lions." No crater-shaped topography is observed in new maps of the island, prepared after actual surveys.

IV. On the Annexed Geological Map.

The annexed geological map, on which my own routes are entered, is for the greater part a miniature copy of KAWASAKI'S geological map, compiled in 1907. Among the changes, which I made in the geology, the most important are those on the region of the 50th. Parallel, and on that of the lakes, Tunnaicha, Chipesani, Wawaitō, and Busse.

Only a little part of the latter region was observed by KATAYAMA, whose observations were used by KAWASAKI in making the whole region Quaternary. The northern coast facing the Okhotsk sea, and the southern facing Aniwa bay were observed, besides the locality of coal on the west side of the northern basin of the twin lake of Chipesani. But he did not see the shores of the Tunnaicha lake, as we judge from his descriptions, nor the interior of the mountains on the sides of these four lakes.

I found the whole northwest shore of the Tunnaicha lake to consist of Tertiary rocks. The land is found very low, between the southern shore of this lake and the northern shore of the northern basin of Chipesani, which one crosses

by a narrow track on his way from Tunnaicha to Chipesani after passing over the former lake by boat. But the hill-slopes on the shores of the Tunnaicha lake are generally too high to be regarded as of Quaternary formation, although they are covered with dense forests and no rock exposures were actually observed on my way across the lake. On the north shore of the northern basin of Chipesani, we find exposures of Tertiary and Palæozoic rocks.

A study of microscopic slides after the publication of KAWASAKI'S map has necessitated some changes in colouration of the areas of Eruptive Rocks.

No fossil localities are distinguished by signs in the map. The cretaceous localities have been already all mentioned in the text. Those in the Tertiaries will be seen in the following table, the place-names occurring in which are mostly to be found on the map, and all the localities observed by myself as well as those by Messrs. SHIMOTOMAI and MURATA are given. Of the other localities there may be some omissions which are due to mistakes in my notes.

Table of Principal Localities of Tertiary Fossils (mostly Mollusks) in Sakhalin.

(1.) On the west coast of the Western Range :—Ambets, Serutonai, Nayashi near Serutonai, Morochi, Horokeshi, Rikuntomari, Ushtomanai, Porotomari, Wenruesan, Komoshirara, Kushunnai, Nayoro, Shiraroro, Tomanai, Tomarioro, Otekoro, Ussu, Chiikai, Tōbuts, Mauka, Tea, Pirochi, Tokombo, Nayashi on the southwestern part of the island, Erumnai, Peshtomanai, etc.

(2.) On the east coast of the Western Range :—Tomarionnai, Dorogawa, Peshuturu, and Uriu on Aniwa bay ; Itatakushnai to the south of Otasan, Shiraraka, Tomichishi, Poronaipo, near Repungenai, Shiruturu, near Chakamaushnai, the Nayoro river, etc.

(3.) In the interior of the Western Range :—Shimizu, near Takinosawa, near Nadejdinskoe, &c. on the Naibuchi river, the lower course of the Khandasa river, etc.

(4.) On the east coast of the Northeastern Mountain-land :—Narumi and many places on the stretch of about 12 km. to its south.

(5.) In the interior of the Northeastern Mountain-land :—The lower course of the Akhmametiëff river.

(6.) On the east coast of the Susuya Mountains :—between Ochopokka and Tunnaicha, and near Omutō.

(7.) On the west coast of the Susuya Mountains :—Merei and many places on the sea-coast from Merei to Soloviyofka and on the road from the latter up to Golyi Mys.

V. Occurrence of Minerals.

The Mineral Industry in the island of Sakhalin is still in its infancy. Before the Russo-Japanese War, 1904-05, the only mines in work were the four coal-mines near Alexandrofsk, said to have then given only about fifty thousand tons altogether a year. The oil-fields at the Nabil lagoon and other places, mentioned in almost all geographical notes connected with the island, remain still unopened. The Serutonai coal-field was only worked for a time and then abandoned. There are no mines at all now in progress in the Japanese part:

After the reannexation of Sakhalin by Japan, the island was visited by our geologists, including myself, who belong or belonged to the Local Government. Many coal-seams as well as some localities of gold-placers were discovered, (see KAWASAKI'S report). It is a wonder that the Russians in this "Prison Island" did not care about the easily workable minerals, such as coal and placer-gold. The island is very long but not broad; and it is therefore not difficult to traverse the island from one coast to another, or from the valley of large rivers towards the sea. More discoveries of useful minerals will be made in the nearest future, and will tend to the speedy opening of the land's interior by the wonderfully attractive power of gold and other substances.

Coals. In the Tertiaries, we find coal-seams sometimes attaining the thickness of more than 3 meters. They are mostly found on the Naibuchi river, on the upper course of the Uriu river, at several places between Tokombo and Shiranushi, in the region of Serutonai, in the Tertiary regions on the west side of the Poronai river, and on the main and branch courses of the Pilevo river, both in the tract of the 50th. Parallel; and other places. In all these localities, there is a black-coloured coal, while near Ochopokka, at Menabets, and on the west shore of the northern basin of the Chipesani lake, there is observed only a bad coal of a dark-brown colour.

Some of the coal-seams are nearly vertical. The age of the coals in the island of Sakhalin is all Tertiary. The fossil leaves, as those we find at Poronai, Ikushumbets, Yūbari, and other coal-fields in Hokkaidō, are only met with in the fields of Naibuchi, Serutonai, and Khandasa. The resemblance with the coal of Ikushumbets is observed in the samples from the Naibuchi river, the Khandasa river, and several other places as Erumani near Sōni on the west coast.

KAWASAKI classified the coal of the island of Sakhalin into two categories: namely, one is more brilliant and more brittle and with more abundant volatile matter than the other.

The formation of natural coke on the contact of the Serutonai coal with a diabasic rock has been already mentioned.

The good coals in sea-beach pebbles and sands on the west coast of Patience bay indicate in parts the real presence of coal there in the land, but are in parts nothing more than pieces fallen from coasting steamers.

Gold-Placers. The petrographical characters as well as the irregularly fissured appearance of the Palæozoic rocks remind us of the features observed in the principal gold-placers in Hokkaidō. Thus I brought round an experienced gold digger during my traverses in the region, of the 50th. Parallel, and ascertained the existence of placers there. In the same manner KATAYAMA found placers at several places near Cape Shiretoko, also on the northwest of the Tunnaicha lake and in other districts.

Sea-beach placers were observed on the east and west coast of the boundary region, and also on the west coast of Aniwa bay.

But none of the quartz-veinlets in the regions of Palæozoic rocks and Crystalline Schists, analyzed in the Civil Administration, gave a good trace of gold.

Limestone. The gray limestone in the Palæozoic occurs at some places. Among them that on the southeast coast of Aniwa bay is situated at a place, from where it can be easily brought out by steamers. In the same region a saccharoidal limestone of a white colour is found.

Crystallized Minerals of scientific interest are not wanting in Sakhalin. Thus on the west coast, we have in the cavities of the granitoid diabase at Shiranushi, as well as at Ambets and vicinity, analcime, natrolite, and prehnite; and in the andesite near Ushtomanai on the same coast, hexagonal columns of white aragonite trillings. There are some crystals of white calcite in -2R found near Wäre, pretty pseudomorphs of chalcedony after fluorite in the compact pyrite-veins through the diabasic andesite of Sōni near Shiranushi, a white massive quartz with moulds of prismatic barite crystals (whose angles were measured by making casts) among the pebbles found by Count KŌZUI ŌTANI near Nayoro on Patience bay, and a pseudomorph of a dirty brownish-gray calcite after a double-ended pyramidal crystal. The last pseudomorph is often more than 10 cm. in length, and resembles thinolite in form, and shows rough striae parallel to the middle edges of the simple pyramid, in which the pseudomorph appears. It is found in the Tertiary shale and its marly nodules on the east and west coast near the 50th. Parallel, in the Tertiary shale on the Naibuchi river with *Cytherea* sp., also in the Tertiary sandstone with fossil shells on the lower course of the Akhmamietieff river, etc. KAWASAKI brought a single incomplete specimen in the Tertiary marl from Ussu on the west coast.

Tōkyō, December, 1907.

摘 要

カラフト島は長さ凡そ九百「キロメートル」、幅の最大なる處凡そ百六十「キロメートル」あり。爰に記す者は主として余が明治三十九年、及び四十年に於て觀察せる處と、地質學の理學士川崎氏、片山氏、及び同學生下斗米、村田兩氏の記事に基き、本文のイギリス文の字句の修正はバヂェラー氏の好意に因れり。

四十年三月カラフト民政署は川崎氏の「カラフト鑛産調査概報」(百四十七頁)を出版して同氏の邦領北部、片山氏の同南部、余が國境地方等に於る觀察を公にせり。

余が觀察せる地方は主として、(一)ドブキ、チペサニ間の山地、(二)カイバトー(海馬島)の東海岸、(三)カラフト西海岸の諸所、(四)五十度境界地方、(五)ポロナイ川本流、(六)シッカよりドブキに至る海岸なり。其他の地方にて余が觀察の及ばざる所には、他の諸氏の觀察を利用せり。

余が巡回中余に對してカラフト廳の熊谷喜一郎氏等、境界劃定員の大島健一氏等の種々の好意を表せられたるを深謝す。又た余がカラフト巡見の機を得るに先ちて、ロシアの學士會院シュミット氏は、同氏等が嘗て採集せるカラフトの化石を(明治二十六、七年)盡く余に示されたるは余が深く感喜する所とす。唯余が遺憾とする所は、余が未だ第三紀化石の最も豊富なるムガチ(アレクサンドロフスクの北)に趣きて實地を見ざりし事なり。

カラフトの地質に關しては、カラフト恢復前には未だ著しき記事なく、唯シュミット氏の白堊紀化石論其他一二の書あるのみなり。

先づ邦領カラフトの地勢上の區分を見るに、ポロナイ川とクコイ川及びススヤ川とを以て、中央を南北に走りたる凹地帶を作り、之を以て東西の兩山地帶を分ちたり。又離島の著しき物は海馬島

にして、火山岩と第三紀層にて成り、北海道のリシリ島及び其他の火山を連結せる線上にあり。

カラフト島の西部の山地は、中央凹地帯の西側にして、白堊紀と第三紀最も廣く現はれ、火山岩等も稍發達せる所あり。又た凹地帯の東には古生層及び結晶片岩が廣大なる面積を有し、之に亞ぎて第三紀の地あるも、白堊紀は其區域頗る小なりとす。又東部にも諸所に火山岩の露出あり。

然れども古火成岩は一般にカラフトにて大なる面積を有する所なし。

カラフトに現はれたる岩石は大略北海道に於る者と同じく、又た石炭層及び諸岩層の走向及び大川の流向に南北の者多きは奇なる現象なるも、カラフトの中央凹地帯と北海道の凹地帯とは全く別物にして、地質上に此二大島の連絡を論ずるは容易なる事に非ず。

カラフトの最古の地層は結晶片岩(本邦古生層の三株系等に類似せり)にして、秩父古生層に善く似たる北海道の古生層は又たカラフトに現はれ、其結晶片岩に對して境界の明瞭ならざるは注意すべき事實とす。

結晶片岩地方にはカスリ岩あり、古生層には輝綠岩等の噴出多く、又た花崗岩の接觸變質も所々に之を見るべし。

白堊紀層は第三紀層と同様の岩質を示し、且つ北海道の上部アンモン介層に於ると同様の化石を有せり。第三紀には種々の化石にて代表せられたる層ありて、特に其植物層は厚き石炭と相接せり、(石炭は北海道の石炭の産狀と性質とに善く似たる點あり)。然れども諸層新古の關係は未だ充分に明かならず、又たロシア領には第三紀地方に石油あり。

第四紀層にはボロナイ川筋にツンドラの厚き泥炭ありて初來の人の目を驚かすのみならず、諸所の河礫中に砂金を有するは注意すべし。又たソロビョフカの介塚には面白き舊土人の土俗品を含

めり。然れども北海道に於ける浮石の厚層はカラフトに無し。

火山岩はカラフトには所々にあり。其西岸に於ては較大なる面積を有する所ありて、其特に廣きウショロ地方のイチャラ等は火山なるが如し。

カラフトの地勢を考ふるに、明治三十九年官版の第一カラフト移住案内の地圖は、新しき地圖の内にて地名の最も正しき者とす。之に先ちて松浦武四郎のカラフト大地圖(版本無し)は、アイヌ語の地名を参照するに最重要なる者とす。又た海岸線に關しては水路部の海圖(二枚物)は割合に眞に近き者と認む。

中央凹地帶(北海道の凹地帶に連絡せず)には、其北部なる屈曲著しきポロナイの川筋にロシア人の謂ゆるツンドラの地ありて、其地は盛夏にも表面より四尺以下は凍り居りて種々の奇なる状態を見るべし。

又た其續きを追へば南にはテルペニヤ灣あり、更に南に趣きてタコイ、スサヤの兩川の平地を過ぎ、アニワの灣に入るべし。殖民適地は主として此凹地帶の南部にあり。又た凹地帶には斷層性の成因を明かにしたる構造を見ざるもポロナイ川の岸に、火山岩の大崖あるは少しく注意すべき者なり。

凹地帶の東側には古き地層の地廣くして、山頂に刻み著しく、特にドブキ以南には海岸に嶮峻なる岩石の突起せる所多し。

又たカタオカ半島の一部(謂ゆる「船越し」在る所)と、遙か南方に遠りたるトンナイチャ、チペサニ間の地には、湖水多くして陷落地の状態を示せり、此チペサニ、トンナイチャ等の湖水は決して尋常の潟には非ず。

西側には分水嶺稍西に偏し、其地の最高部には四千尺位の山もありて、東部の嶮峻なる山頂よりも高し。

海底の形は和田健三氏のカラフト島水産報告(官版)に因りて大要を見るべく、更に海岸の状態を見るときは、東南端を爲せるシ

レトロの岬は花崗岩の峻壁にしてスサ山地の東岸には結晶片岩の峻岸あり。又は所々に火山岩の廣く露れたる海岸は絶壁多し。

テルペニヤ灣のカタオカ半島の如きは、其全體の陸地は段階の平面にして、机の如く延長せるを望むべし。又た段階岸の地方には多く海中の棚ありて、其上に岩石所々に突起して水面上に露れたるを見るべし。又た棚の中に深き溝を穿ちて一見して陸上の谷の續きの如き地勢なるはマウカ及び其南と北との所々に會すべし。

海岸に砂地の大なるものあるはポロナイ河口、ナイブチ川口、スサ川口の外には、マウカの北に於けるノトロの低地にして、特にドブキ地方の砂丘にハヒマツの群生する所あるは一種の奇觀とす。

又た沙岸の瀉の大なるはライチシカを以て最とす。

更に内地經歷の景況に就き記せば次の如き事實あり。

内地は凹地帶上の主なる交通路と、他の一二の横過線路の外には殆ど全く道路無く、群飛する蚊の責は日中には絶へ間無く、又た毒蛇もありて不快少しとせず。又た草木到處に繁茂し、加るに倒木の多き事は北海道よりも一層甚しく、山火事の屢ある事及び其延焼の大なる事も亦北海道に過ぎたり。此等は實に道路無き所の經歷を困難ならしむる者なれども、山間にして獵夫も容易に近づかざる所には、熊の通路自然に一人立ち往來の如くに成りて、探檢者に便利なるも恐熊病者の心を寒からしむ。

夏日の暑は凹地帶の内部海より遠き所を除けば、其勢甚しく猛烈ならず。此等の低地以外には、蚊群も日暮れ後に長く其責を續け得ざるなり。然れども雪の早く來る事、其融け方の遅き事、海の凍る事なども探檢者には不便多し。

然るに地勢は概して緩なるを以て、山間に著るしき瀑の懸る所、大なる絶壁の經歷を妨ぐる所など割合に少きは喜ぶべく、又た海岸には峻所少くして邦領は大部歩行して沿岸を調査經歷し得る

事は之と相伴ふてカラフトの大長所とす。(然れども沿岸に小舟を遣るべき利益はウネリ常に存する東岸カタオカ岬以北には其望甚少しとす。)

地勢の緩なるに準じ高く秀でたる山點少きはカラフトの特徴にして、邦領中最高點の一なる五十度西部なるアイミヤマの邊の如きも四千尺に及ばず。又た地勢に因りて地質の境界を見ることも頗る困難なり。

離島の著るしきは唯カイバトー(海馬島)あるのみ。此島は第三紀層と火山岩とにて成り、火山脈上に立つも格別に火口様の地勢を見ず。又カイヒョー(海豹島)はカタオカ岬の半島の陸地の一部離れたる者なり。

有用鑛物には、ロシア領内に現に坑業する石炭坑あり。又た未だ開坑せざる石油地あり、邦領にはセルトナイ地方、ナイブチ地方、西岸マウカの南、其他に石炭の厚層あり、砂金は境界線東部、ススヤ山地其他に在り、大なる石灰岩層はシレトコ岬の附近なる搬出便利の地にあり。

學術上興味ある結晶鑛物には、西岸五十度地方の沸石類、第三紀地方所々のゲンノーイシ其他あり。

本編附する所の地質圖は川崎氏の版圖と殆ど同様なれども、後に改變を加へたる所あり、最も著るしき差は、トンナイチャ邊の湖水地方を、其低き山地の地質に因りて、大抵第三紀となしたるにあり。

(明治四十年十二月記す)



