

THE VOLCANOES OF JAPAN.

BY JOHN MILNE.

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INTRODUCTION.

In writing about the Volcanoes of Japan, I feel that I am undertaking a task which will be but very imperfectly accomplished. I commenced collecting materials for this subject in the spring of 1877, when, after passing through several interesting volcanic districts, I made the ascent of Asamayama, a volcano situated about 80 miles from Tōkyō. Since this time, whenever an opportunity has presented itself, I have made excursions into the country, and whilst collecting notes chiefly relating to geology and mining, I have given considerable attention to volcanoes. The more important journeys which I have made are briefly as follows:—Along the Nakasendō and the Tōkaidō, through the province of Tamba and the districts near Kōbe and Lake Biwa, through the island of Shikoku and the central portions of Kyūshū, twice overland by different routes from Tōkyō to Aomori, along the more important roads in Yezo, which I have visited six or seven times, and three trips to the Kurile Islands.

By making these journeys I have had the opportunity of see-

ing the more important volcanoes in Japan, and have travelled through many interesting volcanic districts. The volcanoes which I have ascended are Fujisan in 1883 and 1884, Asamayama, Asosan, Ōshima, Bandaisan, Chōkaisan, Ganjusan, Iwakisan, Komagatake, Usuyama, and several minor peaks.

Although the notes that I have personally collected are considerable, they are exceeded by those which I have derived from books which I have consulted. The greater number of these books, which are in the Japanese language, have been translated for me by Mr. N. Mishima. Many of these translations have from time to time appeared in the columns of the *Japan Gazette*. I am sorry to say that only a few of the original books are in my possession, a number of them being in public libraries or in the hands of private persons. Among the more important works, Japanese and European, from which I have derived information the following may be mentioned:—

1.—信州淺間山燒聞書—*Shinshū-Asama Yama yake Bunsho*. Description of an eruption of Asama, in the period of Temmei.

2.—天明信上變異記—*Temmei Shinjō Hen-iki*. The phenomena in Shinshū and Jōshū in the period Temmei.—The account is the same as above.

3.—伊豆國大嶋火山之記—*Izu no Kuni Ōshima Kazan no Ki*. Description of the volcano in the Island of Ōshima, belonging to Izu Province.

4.—青ヶ嶋—*Aogashima* (an island situated in the south, off Hachijō). Contents: Earthquakes and eruptions.

5.—野州白根山震動上申—*Yashū Shiraneyama Shindō-jōshin*. A Report about the Groaning and Trembling of Mount Shirane, in the Province of Kōzuke.

6.—富士降砂記—*Fuji Kōsaki*. About a rain of ashes from Fujiyama.

7.—溫泉嶽燒失記—*Onsengatake Shōshitsu-ki*. Eruption of Onsen-gatake.

8.—駿河國誌富士山事—*Suruga no Kokushi Fujisan-ji*. About Mount Fuji, in the Province of Suruga.

9.—巖木山之記—*Iwakizan no ki*. A manuscript about Mount Iwaki, by KANEMATSU SEIGEN, *shizoku* of Aomori-ken.

10.—岩手山之記—*Iwatezan no ki*. A manuscript about Mount Iwate.

11.—立山之略記—*Tateyama no riakki*. A brief manuscript about Tateyama by SAIKI KAZUMA, *Kochō*.

12.—淺間山之記—*Asamayama no ki*. A manuscript about Asamayama, by FUKAMI NAOEMON, *vice-Kochō*.

- 13.—富士山之記—*Fujiyama no ki*. A manuscript about Fujiyama, by SHIMIZU SUKEEMON.
- 14.—三宅大嶋記—*Mitake Ōshima Ki*. A manuscript about the Islands of *Mitake* and *Ōshima*, by WAKABAYASHI SANSHŌ.
- 15.—嶋原山之記—*Shimabarayama no ki*. A manuscript about the Mountain in Shimabara.
- 16.—阿蘇山之記—*Asozan no ki*. A manuscript about Mount Aso.
- 17.—櫻島山之記—*Sakurajima yama no ki*. A manuscript about the Mountain in the Island of Sakurajima.
- 18.—鶴見山之記—*Tsurumiyama no ki*. A manuscript about Mount Tsurumi.

VOLCANOES IN GENERAL.

- 19.—見聞草—*Mikiki-gusa*. From 9th Vol. of Part 4.
- 20.—阿蘇山燒—*Asozan-yake*. A manuscript about the eruption of Mount Aso.
- 21.—西遊雜記—*Saiyū-zakki*. Miscellaneous manuscripts, written after a travel in the Western Countries.
- 22.—*Chisai Saiyō*.—This is a collection of accounts chiefly relating to earthquakes, in 13 vols. The first volume contains an account of the eruption of Asamayama in the third year of Temmei (1783) the fourth eruption of Asamayama.
- 23.—*Aso Sanjō Reihenki* and *Asosan Yuraryaku*.—The first of these works purports to be a record of miraculous events which have occurred on the top of Mount Aso, while the second is a general history of the same mountain.
- 24.—*Temmei Chinjutsuroku*. This work chiefly refers to the eruption of Asamayama in 1783.
- 25.—*Wakan Sansai Zue*. This is a general encyclopedia. It contains a long account of Fujisan.
- 26.—*Kyūshū Kwazan Ron*, by AOE SHIN. This is a long paper published by the Geographical Society of Japan, giving an account of Volcanoes in Kyūshū.

TRANSACTIONS OF THE SEISMOLOGICAL SOCIETY.

- 27.—T. C. MENDENHALL. Gravity on the summit of Fujiyama, Vol. II.
- 28.—T. WADA. Notes on Fujiyama. Vol. IV. 1862, p. 98.
- 29.—E. NAUMANN. Notes on Secular Changes of Magnetic Declination in Japan. Vol. V.

MITTHEILUNGEN DER DEUTSCHEN GESELLSCHAFT FÜR
NATUR UND VÖLKERKUNDE OSTASIENS.

- 30.—E. NAUMANN. Ueber Erdbeben and Vulcanausbrüche in Japan. Vol. II. Heft 15. 1878

TRANSACTIONS OF THE ASIATIC SOCIETY OF JAPAN.

- 31.—D. H. MARSHALL. Notes on some of the Volcanic Mountains in Japan. Vol. VI. Part II. 1878

GEOLOGICAL MAGAZINE.

- 32.—J. MILNE. A visit to the Volcano of Ōshima. Dec. II. Vol. II. No. 5. 1877, p. 113-159.
- 33.—J. MILNE. On the form of Volcanoes. Dec. II. Vol. V. No. 8, and Dec. II. Vol. VI. No. 11.
- 34.—J. MILNE. A Cruise among the Volcanoes of the Kurile Islands. Dec. II. Vol. VI. No. 8. 1879, p. 990-998.
- 35.—J. MILNE. Geographical distribution of Volcanoes. Dec. II. Vol. VII. No. IV.

MISCELLANEOUS.

36.—J. REIN. Der Fujiyama und seine Besteigung. Petermann's Mittheilungen, 1876, Heft 10.

37.—E. NAUMANN. Die Vulcaninsel Ōshima und ihre jüngste Eruption. Z. d. Deutschen Geologischen Gesellschaft, 1877.

38.—R. VON DRASCHE. Bemerkungen über die Japanischen Vulkane. Asamayama, Takiyama, Iwawasiyama, und Fusi-yama. *Tschermak's Mittheilungen*, 1877, 24-60.

39.—J. MILNE. A Large Crater. *Popular Science Review*.

40.—J. MILNE. The Volcanoes of Japan. *Japan Gazette*. December 31st, 1881; April 15th, 1882; Sept 30th, 1882; and 8 other articles.

41.—*General Histories of Japan*. A list of the Histories to which I have made reference will be found in the Transactions of the Seismological Society, Vol. III., p. 69-70.

42.—For eruptions which have occurred in Yezo and the Kurile Islands, I must refer to my own notes collected while travelling, notes obtained from Mr. H. J. Snow, and the writings of Alex. Perrey (*Documents sur les Tremblements de Terre et les phénomènes Volcanique dans l'archipel des Koureles at au Kamschatka*. 1863.)

The book from which any particular extract has been made is in most cases mentioned in connection with the extract.

In several instances these extracts are practically repetitions of each other only differing perhaps in the matter of dates. On account of these differences I have in a number of cases published more than one account of the same occurrence.

The transposition of dates from the Japanese calendar to the European calendar has been accomplished with the assistance of the chronological tables of the late Mr. William Bramsen.

ASO-SAN.

Aso-san is a mountain in the province of Higo in the island of Kyūshū. In 1879 I described it in an article in the *Popular Science Review*, as a volcano remarkable for the size of its crater, which appears to be from ten to fourteen miles in diameter. Should an actual survey prove this approximation to be anywhere near correct, Aso-san will certainly be one of the most remarkable of terrestrial mountains.

For the most valuable of the records referring to Mount Aso, my thanks are due to Mr. A. Woolley, of the British Consular Service, who in 1878 accompanied me when I visited this mountain. The following account is chiefly derived from the *Aso sanjō reihen ki* (a record of the miraculous events which occurred on the top of Mount Aso). This account has been compared with, and supplemented from the *Aso-san Yura Ryaku* (a general history of Mount Aso).

I have preferred the former of these works as a foundation for the history of Aso-san, as it appears to be more perfect and regular in its chronology than the latter. In some few cases, for what is evidently the description of the same eruption, these works show a difference in their dates. In cases like these both dates have been given. Here and there matter which seems to be superfluous has been omitted, and as far as possible the descriptions have been reduced to a record of events and facts of scientific interest.

One fact which is very noticeable, is that very many of the eruptions are associated with some great calamity, or curious phenomenon, as for instance the death of an emperor, an invasion, the appearance of ships floating in the air, &c. We have also some remarkable examples of the mental effect which seismic and volcanic phenomena have produced. Thus we find an emperor ordering the people to pray for forgiveness of their sins on account of an eruption: a governor presenting a shrine to the god of the mountain to prevent further outbursts: the government ordering the priests to pray that Mount Aso would cease to eject ashes which were burying the crops, &c. It would seem that both earthquakes and volcanoes, if their histories were closely examined, would here, as in other countries, be found to have played an important rôle in engendering superstition and producing mental aberrations, traces of which may possibly yet be met with in certain forms of worship. The records connected with the eruptions of Mount Aso would certainly form valuable material in investigations of this description.

The fame of this mountain seems not to have been confined to Japan alone, but has spread even to China, for a Chinese book says:—

“A smoke rises up to the sky in Mount Aso in Japan. People says that in it there is a precious stone shaped like an egg having a blue colour which shines at night. They worship it, and call the mountain Antikokuzan. The shining smoke on the top has three colours; blue, yellow, and red, and these can be seen for a distance of three miles.”

The records of the eruptions of the mountain are as follow:—

The 29th generation from Jimmu.—Old books state that in the 2nd year of Kiraku, in the time of Kimmei Tennō, flames appeared on the top of Aso Daimyōjin Yama.

Aug., 796.—It is also recorded in ordinary histories (see *Nihon Soshi*) that in the 7th month of the 15th year of Enriaku, the Mikado said: “In the district of Aso, in the Land of Higo, there is a pond or marsh called Shinrei no Ike. Now this pond has dried up, without any cause, to the extent of about 20 *jō*.”

April, 825.—In the 4th month of the 2nd year of Tenchō, the Mikado said: I have heard that a plague is prevailing in several provinces. Dazaifu (a branch government in Kyūshū) has sent a report that, “although the pond, which is situated in the district of Aso, in the Land of Higo, was never known either to dry up or to be inundated, it has now dried up to the extent of 20 *jō*, and this without any apparent cause. In the period styled Yenriaku (A.D. 782 to 805), the same thing occurred. The greatest care was taken about the government at that time. Now, is our government at fault? In ancient times, Shimbun (an emperor of China) warded off earthquakes by repenting his faults in governing; and Sokei (an emperor of China) avoided censure from the unlucky star, by taking especial care in his mode of governing. Also we know that virtue conquers misfortunes, and by doing good, calamities are avoided. We think it is only by divine interference that the

unfortunate occurrences on Mount Aso can be overcome. Order the priests at each Buddhist temple to pray, to abstain from flesh and fish, and to show kindness to poor, to widows, widowers, orphans, and old persons. Do not collect the taxes of the 13th and the 14th years of Kō-nin (822-3) that as yet have not been brought in, and show to all the kindness of my heart."

July, 825.—In the 7th month, a messenger was sent to the (Mikado's mausoleum) at Kashiwabara (in Kyūshū), and the following was said before it:—

"The miraculous pond in the district of Aso, in Higo, has dried up," and so on &c., &c., &c.

It is recorded in *Zokukōki* (Records) that, Dazaifu said that the miraculous pond of Takei-watatsu-no-mikoto in the district of Aso, Higo, was never dry nor ever inundated, even in the time of drought or rainy weather. Now, however, it has dried up for about 40 *jō*, and this without any apparent cause. In the 12th month, a messenger was sent to Daijingū (Great Shintō Temple) of Ise, where he said the following:—

"Recently thou hast been thinking about something. I desire to present some offerings, but there is trouble, for I have not fulfilled thy wishes. This year, the miraculous pond in the district of Aso has dried up more than 40 *jō*. It must be an omen of misfortune. Therefore I am ordered to pay."

In the 3rd month, the Mikado issued the following notification:—

"The miraculous pond in the district of Aso was never known to change the amount of its water, even in the time of drought or during rainy weather. Now, however, it has dried up about 40 *jō* without any cause. Thinking about my faults in the government of the country, I am greatly afraid and have repented. Now I hope to govern the people with the same kind treatment, which my predecessors practised in olden times, and thus to escape the misfortunes of famine, plague,

drought, &c. Order the priests at each Buddhist temple and at each of the Shintō temples to pray for the happiness of the people. Show kindness to the poor, widows, widowers, orphans, and all old persons. Do not confound the innocent with the guilty. Lay before every one my intentions."

In the 5th month, the Mikado issued an order as follows: "I inform Jingō Kōgō (an ancient empress of Japan) that the miraculous pond in the district of Aso has recently dried up for about 40 *jō* without any cause, and in the province of Izu there has been an earthquake. I was greatly frightened, and asked a fortune-teller about these events. His reply was that a drought or a plague might occur. In order that this country might be peacefully ruled by Jingō Kōgō, I send out a messenger, Sangi Yamato-no-kami Masamiō, an official of the second division of the lower fourth rank, and offer up offerings.

In the 6th month, the Mikado issued the following notice: "I inform Daijin, at the head of Isudzugawa, in the district of Watarai, in the province of Ise, that the miraculous pond in the district of Aso has recently dried up about 40 *jō*, and in the province of Izu there has been an earthquake. After divination I learnt that a drought, or a plague, or a war would occur. In order that this country might be peacefully ruled by the Sun-Goddess, I, having chosen a day of happy omen, send out the messengers Daikemmotsu-Jugoinoge Toriyenotsukasa Nakatomi-Minbunodaijō, Shorokujō, and Onakatomi-Ason-Onyō, etc., and present offerings."

27th Jan., 865.—It is recorded in the *San-dai-jitsu-roku* that on the 26th day of the 12th month of the 6th year of Jōkan, Dazaifu sent a report that the miraculous pond of Takeiwatatsu-no-mikoto in the district of Aso began on the night of the 3rd day of the 10th month, to emit sounds, and its water had been thrown up into the air. The water which fell to the east extended about 10 *chō*, spread out like a cloth. Its colour was like the sap of plants. Although we saw it after about 10 days, it had not diminished.

Above Hibajin mountain there were three stone kami, each about 40 *shaku* (feet) high. Two of these were overturned and broken. The governor expected that a drought, an inundation, or a plague would come.

11th March, 865.—On the 10th day of the 2nd month of the 7th year, the Mikado issued the following notification:—"During last winter Dazaifu reported that the miraculous pond in the district of Aso never became dry in the time of drought, nor was it inundated at the time of floods. Now, however, it had overflowed without any cause, and has extended over the neighbouring countries. It was divined that this foretold a war or plague. In consequence of this my mind is greatly disturbed. I have an ancient mirror, which will ward off calamities: and I can avoid misfortune by doing good. Order each Buddhist temple and Shintō shrine to pray that this country may be governed peacefully; show kindness to the poor, widows, widowers, orphans, and old persons. Give up all the taxes which have not yet been offered." At this time the Council of State issued an order of the Mikado over the whole land, saying that, "the Buddhist honours the true mind, and the Shintō the clear. The Buddhist priests and the Shintō priests ought to pray for the peace of the country, by abstaining from flesh and fish for one week. For on reading the Kongō Hanniyakyō (a Buddhist Sūtra) we see it is forbidden to slay all animals. Every governor should show kindness to the poor, widows, widowers, orphans, and old persons, by opening the store-houses of rice. Give up all the taxes before the 2nd year of Ten-an, which have not as yet been offered."

On the 6th and the 14th day of the 8th month of the 9th year, a messenger, Jugoige-Mokuno-suke-Wagenoason-Tsune-mori, by the order of the Mikado, was sent to the temple of Hachiman-Daibosatsu, in the province of Buzen, to present offerings and to state the following:—"By the assistance of Hachiman-Daibosatsu this country has been very peaceful.

Since last year, however, to the present, accidents from heaven and from the earth have never ceased. The miraculous pond in the district of Aso has been filled with water without any cause. Greatly frightened, I asked an explanation for all this, and was told that war, or plague, or famine would occur."

"Therefore, in order that this country might remain undisturbed by the help of Daibosatsu, last month I sent a messenger to you. My efforts, however, were unavailing. As this is a good time, I send a messenger, Makugonnosuke-Jugoi-ge-Wage-no-Ason-Tsune-nori, to present offerings. I beseech you to keep this country in a state of peace, to make all subjects faithful, to cause the high people and the low people to unite, not to make war, and not to disturb the throne."

On the 17th day, Sangi-Jushiinoge-Mamoru, Udaiben-Oyeno-Ason-Otondo, and Jushiinoge Kō-Nakatsusanotayū-Tadanori were sent out to Yamashina-no-Misasagi to say the following:—

"Since last year up till now accidents both from heaven and from the earth have never ceased: the miraculous pond in Asōgori has been inundated without a cause."

On the 6th day of the 8th month of the 9th year, Dazaifu stated that on the night of the 11th day of the 5th month, two strange lights were thrown out on the tops of Shōnii-Kungoto-Takei-watatsu-no-kami mountain and Shōshiinoge, &c., &c., &c., mountains in Asogōri, in the province of Higo.

On the morning of the 12th day, the mountain gave out sounds and roars, until at last a portion of it was broken down, more than 50 *jō* wide and more than 250 *jō* long.

On the 8th day, Dazaifu was ordered to make the people of the province of Bungo pray to be forgiven for their sins, on account of the miracle of the breaking in of the mountain. After this, there is neither common history nor temple record, for about 370 years, but nearly all the events that occurred after the years of Rekinin (1238), are recorded in a book

called Kizuiki ("Description of Strange Matters.") What this says I will now tell you.

1st February, 1239.—On the 26th day of the 12th month of the 1st year of Rekinin, about 30 snakes appeared in the miraculous pond, and black smoke was sent up, and a great many stones fell down. In the next year, Emperor Gotoba died.

25th July, 1068.—Before this, on the 24th day of the 6th month of this 4th year of Jireki, in the time of Gosanjō Tennō, it snowed on Aso-san, and also, in the autumn of the 2nd year of Otoku (1085), in the time of Shirakawa Tennō, Dzaifu reported that it snowed on Aso-san. These are all very strange occurrences.

2nd September, 986.—"It is stated in the 'Meigetsuki' that on the 26th day of the 7th month of the 2nd year of Kanka, it was clear weather. About 10 a.m., at Sansōmon and in Asonomiya the water in the pond was thrown up. Mitsu-iye Nindo issued an order to obtain information about these facts.'

September, 1239.—In the 9th month of the 1st year of En-ō seven water-fowl appeared in the pond.

In the 2nd year of the same, nine large snakes were seen. One of them was larger than the others. At this time the water was blown up about 40 or 50 *jō* high.

1240.—In the 1st year of Ninji, the Emperor Juntoku died.

1242.—In the 3rd year of the same, the Emperor Yojō died.

24th November, 1265.—It is recorded in some books that on the 15th day of the 10th month of the 2nd year of Bun-ei, Aso-san was in eruption.

29th December, 1270.—On the 15th day of the 11th month of the 7th year of Bun-ei, the pond was much disturbed. This happened about 24 times in an hour.

In the 8th year, these disturbances were the same as before. In the 9th year, the Emperor Gosaga died, and the Mongolians attacked the country.

March, 1272.—During the 3rd month of the 9th year of the same period, the pond roared like thunder, throwing up flames towards the sky. Stones were thrown down and bitter waters inundated the land.

22nd November.—On the 1st day of the 11th month the mountain was greatly shaken and stones fell down.

August, 1273.—In the 7th month of the 10th year stones, sand, and clouds enveloped all, and day was like the night. During all this, stones struck against each other in the air.

1274.—In the 11th year the pond dried up, and many large stones fell down. Towards the south and towards the north, valleys became level and the level ground became valleys. All the fields were laid waste, and the Mongolians again invaded us. The pond is usually quiet, but sometimes it dries up and roars.

July, 1281.—In the 7th month of the 4th year of Kō-an, when the Mongolians came to attack us, a blue dragon appeared in the sea of Takashima, in the Province of Hizen. At the same time four falcons were seen flying about over the Mongolian ships. Then the divine wind began to blow, and all their ships were destroyed, and out of 10,000 soldiers only three lived to return to their country.

From the 6th month of this year the flames from the pond reached up towards the heavens, and stones fell down. On the day of the destruction of the Mongolian ships, the pond roared and two war-ships appeared in it. This was a miracle of Aso Myōjin.

1286, Aug.—At 4 o'clock p.m. of the 3rd day of the 8th month of the 9th year, the mountain roared and shook, and smoke in the form of a dragon rose up from the pond, and floated away toward the north-west.

1387.—In the 4th year of Shitoku, many priests said that the most wonderful eruptions were those in the year of Bun-ei, (1264 to 1274) the accidents in the years of Kenji and Rekyō

(1275 to 1277 and 1338 to 1341) and the eruption in the years of Shōhei and Bunchiu (1372 to 1374).

9th October, 1288.—On the 13th day of the 9th month of the 1st year of Shō-ō, 7 fowls like wild ducks were seen on the pond.

25th April, 1305.—At 4 p.m. of the last day of the 3rd year of Kagen, three sun-like fires rose up into the air from out of the pond. They floated away to the north-east. In the 9th month the Emperor Kameyama died.

30th August, 1324.—On the 10th day of the 8th month in the 1st year of Shōchiu, black smoke and red hot stones were thrown up. A letter of Hōjō-Hidetoki, the Governor of Kyūshū, says that "there has been a strange occurrence in Jōgu (Aso), and in consequence I will present a divine-horse to the Aso Daiguji, as a prayer for the government of the Kantō (eastern provinces) on the 11th day of the 8th month."

April, 1331.—In the 3rd month of the 1st year of Genkō, the volcano burnt violently and a dragon appeared in the smoke. The strange fowls were still staying on the side of the pond. From the 11th month to the 5th month of the 3rd year, the pond both roared and shook and the fiery stones sounded loudly as they struck against each other. The country was greatly disturbed and all the people of Hōjo were destroyed.

30th January, 1335.—On the 5th day of the 1st month in the 2nd year of Kemmu, the pond roared and shook, and at 8 a.m. of the 6th day, stones were thrown out and a thing like a wheel was seen in the smoke, raising up into the air; the temples and all the other buildings were destroyed.

On the 23rd day of the 2nd month, fiery stones and sand came down, and the heaven was covered with black smoke. In the same year, Son-Un-Hoshinno was killed by Tadayoshi: in the 4th month of the 3rd year, the Emperor Gofushimi died: in the 12th month, the Emperor Godaigo went to Yoshino-yama and this country was again disturbed.

2nd February, 1340.—At 4 p.m. of the 4th day in the 1st

month of the 3rd year of Rekyō, or the 2nd year of Kōkoku, it roared like thunder and much black smoke was blown up. The flames reached up to the sky and fire stones were falling. The temples and the other buildings were all destroyed.

On the 19th day of the same month, a mountain of sand was formed in the northern part of the pond. It was much higher than the top of Aso-san. In some books it is recorded that "it was in the 1st year of Kō-ei (1342) that the water of the pond overflowed and destroyed the main temple." However, this is not recorded in this book. The 1st year of Kōyei is the 4th year of Kōkoku.

12th December, 1375.—On the 19th day of the 11th month of the 1st year of Eiwa, or the 1st year of Tenjin, the pond was again roaring and shaking. Fiery stones were thrown out, and the water inundated the land.

23rd January, 1376.—At 8 p.m. on the 2nd day of the 1st month in the 2nd year of the same period, the water again flowed over, and at 10 a.m. of the 20th day in the 3rd month in the 3rd year, red hot stones fell down, water flowed over, and the temples and other buildings were swept away.

June, 1387.—25th day 5th month, 4th year of Shitoku, a cave was formed, and water was sent 10 feet high. 1 a.m. on the 3rd day, 5th month, half the cave became a pit.

8th October, 1388.—On the 8th day of the 9th month in the 2nd year of Kakei, a snowy white heron stopped for 3 days and nights on the burnt stones in the pond. After this it flew away to the south.

1390.—In the 1st year of Meitoku, the country suffered much disturbance.

1st May, 1434.—At 2 p.m. on the 22nd day of the 3rd month in the 6th year of Yeikyō, black smoke was thrown from the pond and muddy water inundated the land.

At 8 a.m. of the 11th day in the 4th month, fiery stones were thrown up, and at this time the Emperor Gokomatsu died.

At 2 p.m. of the 5th day of the 12th month of the 9th year, the mountain was extremely fiery. On the 15th day of the 1st month of the 10th year, the pond roared and shook, and the fire burnt fiercely. In the same year Mochi-uji rebelled.

1441.—In the 1st year of Kakitsu, Akamatsu-Mitsu-suke put Yoshinori, the Shōgun, to death.

October, 1473.—From the 10th month of the 5th year of Bummei to the spring of the next year, the eruption was very great, and two things like the sun appeared in the smoke. The fiery stones fell down, and the temples and the other buildings were destroyed. In certain books it is said that on the 11th day of the 4th month of the 5th year of Bummei (7th May, 1473), the pond roared and shook, and the smoke rose up into the air. It did not cease for very long.

1484, December 28th.—From the 10th day of the 12th month of the 16th year to the 17th year, fiery stones and black smoke were continuously emitted, and a sandy mountain was formed in the northern part of the pond. At this time, Koretada, Daiguji died, and more than half the priests deserted the mountain.

February, 1505.—In the 1st month of the 2nd year of Eishō, fiery stones and black smoke were thrown up and a general famine prevailed.

5th February, 1522.—On the 9th day of the 1st month of the 2nd year of Dai-ei, fiery stones and black were emitted and two mountains of ash were formed in the pond. On their tops two things like the sun appeared: Kyōto was greatly disturbed.

7th July, 1533.—On the 15th day of the 6th month in the 2nd year of Tembun, the smoke rose up, and muddy waters inundated the land. It is described in a certain book that on the 27th day of the 3rd month in the 19th year of Tembun (13th April 1550), a cloud like a flag floated over the west side of Aso-san; and in the 20th year, a water fowl, with a black back and a white bosom, came to Haraigawa in Aso, but on

the 23rd day of the 1st month of the 21st year (17th Feb. 1552), it died." This is not recorded in this book, because it did not relate to the pond.

1558.—In the 1st year of Eiroku, a new cave was formed on Aso-san, and from the spring of the 2nd year until the summer, the drought continued, and during the 8th month the wind was very strong. In this year another new cave was formed, and on the 7th day of the 11th month, Koretoyo died.

March, 1562. In the 2nd month of the 5th year of Eiroku, black smoke, stones, and sulphur were emitted. The water of Shirakawa became turbid. All the fish were killed.

December, 1564.—In the 11th month of the 7th year, the fire raged and much black smoke was given out. In the 5th month of the 8th year, the Shōgun Yoshiteru was put to death, and in the 2nd year of Genki (1571), this country suffered from continuous rain, and a famine prevailed.

5th November, 1576.—In the 15th day of the 10th month of the 4th year of Tenshō, the eruption was great, and the black smoke rose up.—The country was much disturbed.

7th February, 1582.—On the 15th day, of the 1st month of the 10th year of the same period, black smoke and fiery stones were again thrown up; at this time Nobunaga was killed.

24th December, 1583.—On the 11th day of the 11th month of the 11th year of the same, by an inundation of the water from the pond, the main temple was destroyed and the images of Jikei Daishi and Son-ei Daishi were carried away.

August, 1584.—In the 7th month of the 12th year, sand and sulphur fell down, and in the fields the grass was destroyed.

1587.—In the 15th year, the eruption was severe and two mountains of ash were formed in the pond.

From the 13th year until now, Kyūshū has been disturbed. In this year, however, Taikō attacked Satsuma and Aso was confiscated, a great many priests being dispersed.

1592.—In the 1st year of Bunroku, black smoke issued in

great quantity and a sand mountain was formed. During the next year, the Emperor Ōgimachi died, and Koremitsu was sentenced to death.

December, 1598 to 1599.—From the 12th month of the 3rd year of Keichō to the 4th year, stones and black smoke were sent up in great quantity, and the fire burnt. In this same year Taikō Hideyoshi died; and in the 5th year the country was much disturbed. In the 16th year, misfortunes still continued and Kiyomasa-Ason died.

12th August, 1613.—On the 26th day of the 6th month of the 18th year of the same Emperor Gomizunō, bitter water was thrown up: black smoke covered the heavens: fiery stones fell all over the district.

1615.—In the 1st year of Genna, the Ōsaka castle was taken, and in the 2nd year, Ieyasu died. In the 8th month of the 3rd year, Emperor Goyōzei died.

3rd June, 1620.—On the 3rd day of the 5th month of the 6th year of Genna, bitter water was again blown out.

December, 1631.—In the 11th month of the 8th year of Kan-
ei, the mountain roared and shook, and black smoke and fiery stones were thrown out in quantity. Bitter waters inundated the land. These were very hot. The people could not cross over even at its lower part. In the first month of the 9th year (Feb. 1632), Hidetada died, and in the 4th month, Tadahiro had his dominion confiscated.

29th September, 1637.—On the 11th and 17th days of the 8th month in the 14th year of the same period, much black smoke issued from the mountain, and sulphur and ashes fell down. At this time a rebellion occurred in Shimabara in Kyūshū.

July to August, 1649.—From the 6th month of the 2nd year of Keian to the 7th month, the mountain roared and shook like thunder, and black smoke and fiery stones together with sulphur were thrown up.

In the 1st month of the 4th year of Keian there was roaring. From the 7th month the roaring continued until next year.

January, 1650.—In the 12th month of the same year, Mitsunao-Ason died, and in the next year Ietada died.

February, 1668.—In the 1st month of the 8th year of Kambun, the mountain roared and shook. It began to roar and shake again in the 7th month and did not cease until the next year.

16th February, 1675.—At 10 a.m. of the 22nd day of the 1st month of the 3rd year of Empo, the mountain roared and shook. Fiery stones were thrown out.

1st May, 1683.—On the 5th day of the 4th month in the 3rd year of Tenwa, two cranes died by the side of the pond.

May, 1683.—In the 5th month, it roared and shook like thunder and the mud boiled.

April, 1691.—In the 4th month of the 4th year of Genroku the northern part of the pond roared and shook, and ashes fell down. During the next year, it did not cease.

May, 1691.—At 10 a.m. on the 17th day of the 5th month, it began to roar and shake again and continued until 12 o'clock at noon. Many fiery stones were thrown up, and black smoke extended towards the east. Between Sakanashi-mura and Miyachi-mura it was very dark, and lamps were needed. The people missed their way, and birds were choked with the smoke and died.

September, 1708.—In the 8th month of the 5th year of Hōei the water in the southern part of the pond changed to a red colour, and in the 12th month, it dried up.

13th February, 1709.—On the 4th day of the 1st month of the 6th year, the mountain roared and shook, and a great many caves were formed on the side of the pond. Fifteen of these were very large, but the others were small and numerous. Mud was thrown up to the height of 3 or 4 *ken*, and bitter water inundated the land. At this time flames and stones were

given out and the mountain roared and shook. During this month Jokenkō died, and in the 12th month, the Emperor died. The *Kizuki* ends here.

December, 1764.—12th month of the 1st year of Meiwa, the pond on the top of Asosan sent out smoke more violently than usual.

February and October, 1765.—From the beginning of the 1st month of the 2nd year to the 9th month, the mountain roared and shook. Sometimes it sounded as if large stones were being thrown down from the top of some high mountain, and at other times it roared as if several hundred thunder clouds had simultaneously burst. It did not cease for many days. Black smoke rose up and extended to the north-east, until it reached to Sakanashi-mura and Namino-mura. Stones fell down. Plants and all the grass were destroyed, and the oxen had nothing to eat.

It is written in the book, called “Dojirigawa Are-ki (description of the inundation of the river Dojiri near Asosan), published by Takarazu Nagateru, which is an appendix to the Asosan Meidōki (description of the roaring and sounding of Asosan), that in the 12th month of the 1st year of Meiwa (Dec. 1764) the pond on the top of Asosan sent out smoke more violently than usual from the commencement of the 1st month of the 2nd year to the 9th month; the mountain roared and shook. Sometimes it sounded as if large stones were being thrown down from some high mountain and sometimes it sounded as if several hundred thunder clouds had simultaneously burst.

People at a distance of 3 or 4 *ri* could not sleep neither day nor night. In many places ten *ri* distant, as at Tsurusaki and Funai in Bungo, Chikugo, Hizen, Satsuma, Ashikita, Amakura and Yatsushiro in Higo, ashes fell down in quantities. In Matoishi, Sakanashi, Otohime and Nagakusa in Higo, the greatest quantity fell.

On the 13th day of the 4th month, a farmer in Nagakusa

spread out a mat to find out the amount of ash which fell. Between morning and evening it collected at the rate of 8 *shō* (1 *shō*=3 pints) per *tsubo* (1 *tsubo*=3.9 square yards.) It fell in different places according to the wind. The leaves and branches of trees were covered with ashes as if with snow. When the wind blew a little the ashes on the trees and other plants in Izumiyama, Yonezuka and Janoo, were shaken down, and the Aso valley looked as if it were covered with fog or smoke. Neither the mountains, the trees, nor the rivers could be seen beyond a distance of 5 or 6 *chō* (1 *chō*=119.3 yards). The ash, which accumulated every day, was carried down into the Dojirigawa and Nishigawara by the spring rains, and these rivers were covered over like level ground.

On the 13th day of the 5th month, the houses and other buildings were inundated, and on the 27th day of the same month, it rained heavily and by 12 p.m. the water entered into the houses. To keep this water back was very difficult. While they were busy at this work, a strong wind and rain came on, so that they could not wear rain-mats. The thunder and the lightening were frightful. In places, the water was like a large river. Two bridges were carried away; and large waves struck against each other. The people could hardly stand, even by the help of the trees and bamboos. The water in the wells was mixed with ashes. For this reason, they boiled the rice with water from the lower villages. All the country was covered with ashes. I removed my family to Nakano, in the autumn of the same year. The people named this place Shindojirimura. As I was very busy, I could not describe all the facts, but in the Asosan Meidōki and the Dojirigawa Are-ki they are minutely described.

5th September, 1804. On the 2nd day of the 8th month of the 1st year Bunka, the pond roared and shook.

27th September 1804. On the 26th day of the 11th month, the mountain roared and shook, and a small pond was suddenly formed.

30th August 1806. The Daimyō of Higo on the 8th day of the 8th month of the 12th year of Bunka gave the following report on the burning of Asosan :

A mountain called Asosan, under my jurisdiction, has had a sulphur like nature from time immemorial. It is always smoking at the top.

At the beginning of the 3rd month this year, the mountain suddenly began to groan and tremble ; and about the middle of the same month, smoke began to issue more abundantly than usual and the people of the neighbouring districts were very unsettled in their minds.

Its activity increased day by day up to the beginning of the 5th month, when at last another crater at the top was opened, and it ejected a great mass of stones of large size. Fire also appeared. When the colour of the smoke was white, the ashes were also white ; but when it was black, they also were black. Sometimes mud mixed with sulphur fell on the ground. Wherever the poisonous gas was felt, not only were many valleys and much cultivated ground destroyed but living creatures were also injured. In the village of Aso no productions of the soil nor any food for the cattle could be obtained. In consequence of this, we took food for our cattle from other places, but there was great difficulty in obtaining sufficient.

Besides the village mentioned above, there are a great many other villages into which mud mixed with sulphur and ashes streamed, and in such places all kinds of vegetables were destroyed. About this time it also rained very heavily and the river which runs just below the mountain and which borders the villages of Aso, Aishi, Ekijo, Iida and Wabima overflowed. In consequence of this overflow, the water together with mud and sand streamed into the five villages where the produce had been spoiled.

The accidents in the 12th year of Bunka were those which followed the accidents in Anei (1772 to 1780). They are the most terrible. They are described here so that future genera-

tions may know about the frightful scenes which occurred. The pond was always overflowing with water, until at last it began to dry gradually, and at the end of the 10th month it dried up altogether, forming a crater in the bottom. After this it burnt most violently, and the rim of the crater became of a purplish-yellow colour. In the crater it roared and shook, and gave out a smell of sulphur. In the beginning of the 5th month, black smoke began to issue, and gradually it became very violent. In the 6th month, it covered the heaven for a distance of about 2 ri, and the day was like the darkest night. At a distance of about 1 *chō* around the pond, lapilli fell and flames were blown up. The appearance of the stones which were being thrown up, when looked at from a distance, was like a great many crows. They were red balls of fire in the smoke. Whilst flying about, they struck each other and the light they produced was more intense than lightning. The sounds they made were just like thunder. From the 9th month, it became gradually quiet, but the fields and the grass at the foot of the mountain were covered with earth. Every thing was laid waste. Therefore whenever the water in the pond was observed to dry up and a crater was formed at the bottom of the pond and the blowing became violent, prayers were always offered.

A second account is as follows :

In the commencement of the summer of the 12th year of Bunka, Asosan burnt fiercely and black smoke was sent up, looking as if the mountain had one more new peak. It always covered the highest peak, and extended in a direction depending on the wind. It often reached to far distant peaks. When most violent, it threw up rocks, to move which it would require a thousand men. As these fell, they were often broken in pieces, by striking against each other. The fire in the air was like lightning and the sounds were like a thousand thunders. Ashes fell so thickly that the sun could not be seen : the heavens seemed very frightful. It did not cease for many months.

A third account runs as follows :

In the 6th month, it rained very much: and the ashes, which were heaped up like snow on the top and at the foot of the mountain, were carried away into the valleys, and entered into the Shirakawa. The water of the Shirakawa became of a white colour. The fishes became sick, and after escaping into the sea they died along with others, which were in the waters near the place where the Shirakawa entered. The cows and horses could not eat the grass that was covered with the ashes. Those which tried to do so became sick. The plants near to the foot of the mountain all withered, and the fields were all laid waste. In consequence of this the poor farmers were greatly distressed, and the chief officers in each village sent in a report about these facts.

22nd November, 1826. At about 12 p.m. on the 23rd day of the 10th month of the 9th year of Bunsei, fire, sand and stones issued from the pond, and the whole mountain roared and shook. The principal temple and other buildings were all destroyed. They began to rebuild these so quickly that the people called them Todokōri-yama.

April, 1827. In the 4th month of the 10th year of Bunsei, ashes fell down everywhere and the fields were laid waste.

12th November, 1827. At 10 a.m. of the 23rd day, of the 9th month, it roared and shook like thunder. Flames reached up to heaven, and sand and clouds were everywhere. At this time a new cave was formed on the southern side of the first Torii (Shintō temple gate). At this time, the people who came here to pray were prevented from breathing by the quantities of ashes which were falling. Many of these died at a place about 20 *chō* (1 *chō* = 119.3 yards) to the south of the pond.

1830. In the 2nd month of the 13th year, black smoke once more reached up towards heaven, and stones fell down.

This continued until the following month. All vegetation was destroyed and the people were greatly afflicted.

11th August, 1830. On the 23rd day of the 6th month of the 1st year of Tempō, the pond roared and shook, fire and ashes were thrown out, and it was very difficult to see even for a short distance. On the next morning, a mountain several hundred fathoms high was suddenly made on the west side of the pond. The people called this Asama-yama. Afterwards it continued to roar and shake, and to blow up fire and stones for 2 or 3 years, and all the villages to the south of Aso San had in consequence bad harvests. The government frequently ordered the priests of Aso to pray for quiet.

26th February, 1854. At 2 p.m., of the 29th day of the 1st month of the 7th year of Kaei, the fire burst out from the pond, the mud boiled up and the whole mountain was very hot. At this time, three people who had come to pray were killed. Two of them died at once, but the other one who was only half burnt was carried back to the branch temple where he died. Since the 1st year of Meiji many misfortunes have occurred; but these are not all described here, because they do not appear to have any connection with the mountain.

26th February, 1854. On the 29th day of the 1st month in the 1st year of Ansei, the mountain roared and shook, and muddy water was thrown up.

1st December, 1872. On the 1st day of the 11th month of the 5th year of Meiji, it again roared and shook, muddy water was thrown up and several sulphur collectors were killed. After this, it often roared and shook, smoke covered the sky, and fiery stones struck against each other both during the day and night. The sound of it was like thunder. Bitter water inundated the land, and even at the shallowest part no one could cross over, it being so very hot.

The following account of the same eruption is taken from the "Mittheilungen der Deutschen Gesellschaft für Natur und Völkerkunde Ostasiens Vol. I. 1873, Bericht aus Shirakawa Ken über die Kürzlich stattgefundenen Ausbrüche des Asodsan," From the newspaper *Dsasai*. A. v. K.

News from Shirakawa Ken respecting the late eruption of Aso-san.

On the afternoon of the 1st December, 1872, the volcano Aso San which was active long since began suddenly to heave, a violent roaring being heard at the same time. A thick column of smoke rose immediately into the air, and sand with rocks varying in size from a cannon ball to that of a large boulder which 20 men would not have been able to move were thrown up on all sides. Unfortunately just at this time a large number of workmen were engaged at the sulphur mines in the mountains. Four of these were immediately killed and the remainder without exception were more or less injured. Gradually the heaving and the eruption became weaker and weaker, and finally it completely ceased. On the 24th December the mountain began to quake anew and to throw out fire, smoke, and small stones. This was repeated daily. A more violent heave of the earth was noticed now and again. A large number of hot springs issued forth everywhere, flowing down the mountain and into the river Shirakawa which rising in Aso San enters the sea at the town of Kumamoto after a course of 15 *ri* (1 *ri*=2.4 miles). The water of this river was in consequence so sulphurous that it indeed became a white river, or Shirakawa ("white river") and all the fish and mollusca were poisoned. Since the 1st March 1873, the shocks and thunder-like noises, especially in the afternoon and evening have become more violent so that in a village not far from the volcano the windows and doors clatter incessantly at night. The whole sky is red with the fire. The ejection a daily cover the neighbourhood within a circle of from 7 to 8 *ri*. Day is almost as dark as night. Earth and sand are carried by the wind 4 or 5 *ri* into the interior and daily cover the ground to the height of an inch. According to an official report the appearance of the fields and vegetable gardens belonging to the villages in the neighbourhood present a sad sight. As the strength of the eruptions depends upon the amount of sulphur in the mountain, the district officials have been ordered to make

a closer examination, and to report on the damages caused to the crops.

A statement respecting this eruption of Asosan by the Kōchō of Kurogawa to the Kumamoto Ken is as follows :—

In the winter of last year (1873) sounds were heard and white and black smoke observed proceeding from the mountain in this district; and on the 7th of this month (February 1873) in the morning, a southern wind blowing at the time, the ground in the neighbourhood of the village of Kurokawa-gumi for more than $1\frac{1}{2}$ *ri* from east to west, and $1\frac{1}{2}$ *ri* to the north commenced to quake. Ashes were thrown out in places one inch and in others only 1 *bu* ($\frac{1}{10}$ inch) while the depth in the rice-fields was unknown. The leaves of the pine, wheat, &c. appeared of a red colour. In the morning of the 13th at 6 o'clock the earth quaked and sounds were heard on an average twice per hour. At 6 o'clock on the morning of the 14th there were two or three great shocks. On the 23rd at 6 in the morning the sounds and quakes were unusually violent. From 6 o'clock again there were violent sounds and earthquakes both great and small,—the wind at the time being southerly. Neither old or young could sleep. On the 24th the shocks continued, but the ejection of dust from the mountain ceased. It was of a grey colour at first, but afterwards for a time it was red. At the date of writing it was impossible to estimate the damage. The ashes were thickest at Kurogawa-gami and Higashi Kurogawa.

The five Dake (peaks) of Asosan are as following :—

Kineshima-dake.	|	Naka-dake.	|	Neko-dake.
Eboshi-dake.	|	Taka-dake.	|	

1. Kineshima-dake, which is sometimes called Ojo-dake, lies to the west of Naka-dake. The place in ancient times called Muke is on this peak.

2. Eboshi-dake, which is sometimes called Raiga-zan or Gomen-zan, lies to the south of Kineshima-dake, and to the south-west of Naga-dake. Plants and grass grow on it.

3. Naka-dake is a bald mountain which is sometimes called Mitake. On it is the present Miike. On this mountain, the main temple is standing. In the *Tsukushi-Fūdoki* ("Topography of Tsukushi") it is called Naka-dake. You can see from Kumamoto to Masuki.

4. Taka-dake is to the east of Naka-dake; and from the top towards the west it is bare, but to the east it is covered with plants. It is highest among the five, and when it is clear weather, the ocean on the east, the west and the south are seen at one time. The highest point is very cold, and until the end of the 4th month, the plants do not sprout. At the end of the 8th month, fog descends. Even when the other mountains are free from clouds, this peak is sometimes covered with them, and snow lies on its slopes.

5. On Neko-dake, which is sometimes called Shichimenzan, there are plants. It is to the east of Taka-dake, and next to it. Its highest point is very steep. Even wild hogs and deer cannot climb it. The people say it is so called because the king of cats lived there, and on the last day of every month all the cats in the district congregate there. This is very ridiculous. It is also called Hiremenji. Besides these five peaks, there are also the mountains called O-dake, Yoko-date, Tatsumune-dake, Sara-yama, Taka-yama, etc.

Mr. Aoe Shiu, in his account of the Volcanoes of Kyūshū (Kyūshū Kwanzan) speaks of Aso-san as follows:

The *Tsukushi Fūdoki* in the *Shoku Nihonki* says, "At a distance of twenty *ri* in a south-west direction from Asono-agata, there is a bald mountain called Asonodake. On its top there is a miraculous marsh encircled by a stone wall, the length of which is fifty *jō*, the breadth one hundred *jō* and depth twenty *jō*. Its scenery is so beautiful that I cannot describe it. Many curious occurrences have taken place on its summit. The water in the marsh is sometimes very full and overflows to the south, and it then runs into the

Shirakawa and many fish become sick and die. The people of this place call it the niga-mizu (bitter water)."

This mountain is situate over the four *Agata*. It reaches above the clouds and is the highest peak of five mountains. The little streams which come from this marsh are the sources of many large rivers. As this mountain is supposed to be in the centre of the earth, it is also called Chyūgaku: that is, Asonojingū.

The five mountains are the following. Takadake lies to the north-east of the present volcano, which is the highest in Asogōri. It cannot be seen from Kumamoto. The second is Wajodake the old volcano. It can be seen from Kumamoto. Then come Nekodake, and Mitake the present volcano; and lastly Nekodake which is of the same height as Mitake.

Among the few eruptions of Mount Aso which are mentioned by Mr. Aoe Shiu I find the following which do not appear in the previous text. Where two eruptions nearly coincide in time it is probable that they are really the same eruptions which have been confused by those who drew up the chronicles.

In the *Zoku Nihon Kōki* we read that "in the 4th month of the 7th year of Shōwa (May 840), Jushii no Jō (a rank) was granted to Jushii no Ge Kun Gotō Kemban Ryūjin (the name of the god), but the other gods were the same as before. In the 9th month, the Dazaifu reported that the pond of Kemban Ryūjin in Asogōri, whether there was drought or long rain, neither decreased or increased its water, but now it has dried about 400 feet. In the 2nd month of the 8th year of Shōwa (Feb. 841), the Dazaifu reported that the pond of Shinrei (miracle) in Asogōri in Higo, also decreased 400 feet. On the 6th day of the 8th month of the 9th year of Jōkan (7 September, 867) the Dazaifu reported that on the peak, on which Shō Nii Kun Gotō Take Iwatatsu no Kami lives, there was a strange light in the night of the 11th day of the fifth month, and on the morning of the 12th day, the peak shook and a portion more than 500 feet in width and 2,500 feet in

length, fell. On the 8th day, the Dazaifu was commanded to hold a festival and petition the Kami in reference to this strange fall of the mountain. In the 7th month of the 6th year of Bunei (July, 1269), Asozan sent forth smoke. In the 17th day of the 6th month of the 4th year of Genroku (12 July, 1691), Asozan was very dark from Minokoku (10 o'clock a.m.) to Sarunokoku (4 o'clock p.m.), and stones fell like rain. In the beginning of the 3rd month of the 11th year of Bunsei (April 1828), Asozan roared and shook and sent forth smoke. From the beginning of the 4th month, its shaking was particularly violent, and from the beginning of the 5th month the smoke and the shaking gradually became more violent. It sent up flames and its top broke away. When the colour of the smoke was white, sand came down, but when it was black, burnt sand came down. The sulphur, ashes and sand covered the fields and laid them waste. All animals fell dead. It did not cease day and night. Therefore the people and the crows and oxen in Asogōri had nothing to eat. Those who lived in the neighbouring tracts of Asogōri, were also inflicted with the calamity. The rivers which run through the peak of Asozan run separately to Asogōri, Goshigōri, Masukigōri, Akutagōri and Takumagōri. As they are streams which water the fields, when it rains many days, they melt away the sulphur and the water becomes impregnated with sulphur. Therefore vegetables in these five tracts of country were also desolated. The falling of the sand did not cease even a moment, and it can not be judged when it will stop.

I will conclude these notes on Asosan by a few of my own observations made when I visited that mountain at the end of 1878. In company with Mr. A. Wooley of the British Consular Service, I approached Asosan from Kumamoto. Our road led through the village of Ozu. From this point the ascent was gentle. On the left was Kuratake (*Fig. 2, Plate I.*) with a rugged hollow on its left side looking like a breached crater. Continuing the ascent we reached the top of the pass called Futaiyai no tōge; and here before us there was a view

which was as striking as it was unexpected (*Fig. 4, Plate I.*). Because the ascent had been so long and gentle we naturally expected an equally gentle descent upon the other side, but instead found that we had reached the edge of what was nothing more than a deep pit, circular in form and with perpendicular sides. These sides near their upper parts shewed a broken stratification so characteristic of the sides of many craters. At a few points the cliff-like sides of the pit had been broken down to form steep slopes. Looking at the pit from the commanding position where we stood, I estimated its width at seven miles; but when we descended and tried to walk across it we found that the estimate was much too small. In the center of the pit there is an irregular block of hills the central peak of which is always giving off large clouds of steam. Our descent to the crater plain was by a zig-zag path way, the depth at this point being about 600 feet. That afternoon we walked a distance of five miles to a village called Bojo, and as this appeared to be about half-way across the crater, the width in this direction must be about ten miles. From a map of the crater sketched by our host in Bojo on which he marked the distance from village to village, the diameter of the crater as measured along roads must in some directions be as much as fourteen miles. Inside the crater these are about forty villages, twenty of which are of moderate size. If these contained on the average one hundred people, then there are living in the crater of Asosan at least 4,000 people. Near Bojo there are some temples, while on the summit of the mountain there are smaller temples and shrines where during fixed seasons crowds of people come to worship the deities of the mountain. The ascent of the central peak is easy. Before us there was a rugged peak called Nekodake, part of which looked like a ruined crater. To the right and to the left was a gentle slope covered with brown grass. At 400 feet above Bojo we came to patches of snow and as we neared the top we crossed one or two old lava streams. At a height of 2,000 feet above Bojo or about 3,600 feet above the sea, we were on a level with

the upper crater of Mount Aso, which is a huge black pit giving off clouds of steam. All the rocks of this point appeared to be andesites similar to those which form the ring wall of the outer crater. On the right was a hill called Dobindake, which rose about 500 feet above the crater. The extreme height of Aso-san above sea level is therefore perhaps a little over 5,000 feet. Satow gives the height of Takadake as 4,100 feet. From this point we had a capital view of the ring wall which surrounded us. On the northern side the cliffs were almost everywhere perpendicular, while on the south, which is the side on which we descended, they are more worn and in places constitute rugged hills. Next day we left the crater by a breach in its north west side. It is through this opening that the Shirokawa flows, the river which with its tributaries drains the crater plain.

The following extracts from Scrope's valuable work on volcanoes may serve to compare the crater of Aso-san with other large craters in the world:—

In St. Helena Mr. Scrope tells us that there is a trachytic volcano encircled by a broken ring of basalt, the area of which measures eight miles by four.

In the Mauritius there is a crater the shortest diameter of which is thirteen miles.

In St. Jago (Cape de Verde Islands) there is a similar crater.

The Cirque of Teneriffe is eight miles by six. Pantellaria (near Sicily) has traces of a crater twelve miles in diameter. The rock is trachytic.

Bolsena (an oval lake basin) is twelve miles in diameter.

Papandayang (Java) is a hollow fifteen miles by six, supposed to have been formed by the blowing off of the entire summit of a mountain by long continued explosions.

Bromo (Java) is a crater four or five miles in diameter with perpendicular sides a thousand feet in height.

If a cross section of Asosan is drawn its outside slope ap-

pears to be about six degrees, and by continuing the slopes upwards we obtain a representation of the portion which, if it ever existed, has been blown away. Allowing 35 cubic miles of material for the cone and about 17 miles for the present crater, we have to account for the disappearance of 52 cubic miles of rock. Although I crossed the outside of the mountain by two paths, I did not see any traces of the missing materials.

My own opinion is that the general form of the mountain is not due to a paroxysmal blowing off of its upper portion but that it was built up gradually.

When I first read the accounts of the pond on Mount Aso, I conceived the idea that at one time the large crater had been filled with water. Since visiting the mountain, I see that this is improbable, the pond referred to perhaps being a small lake near the center of the old crater. The group of central cones probably occupy the site of this pond.

The following table of the eruptions of mount Aso shows that there has been the greatest activity during the winter months :

ASOSAN.

Kira-ku 2d. Year.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Un- kn'wn
796								—					—
825													—
840					—								—
841		—											—
864											6		—
867									14				—
986									2				—
1230		1											—
1205											24		—
1269							—						—
1270												29	—
1271													—
1272			—								22		—
1272													—
1273								—					—
1274													—
1281							—						—
1286									23				—
1305				25									—
1324				—				30					—
1331													—
1335	30												—
1340		2											—
1375												12	—
1376	—												—
1387						—							—
1388										8			—
1390													—
1434					1								—
1473										—			—
1484												28	—
1505		—											—
1522		5											—
1533							7						—
1558													—
1562			—										—
1564													—
1576											5		—
1582		7											—
1583												24	—
1584								—					—
1587													—
1592													—
1598													—
1613								12					—
1620						3							—
1631													—
1637									29				—
1640							—						—
1668													—
1675		16											—
1683				—									—
1691				—									—
1709		13											—
1754													—
1765		—											—
1804									5				—
1806								30					—
1826											22		—
1827				—								12	—
1827													—
1828				—									—
1830								11					—
1854		26											—
1872												1	—
1874		7											—
Total	2	12	2	5	3	2	4	8	4	2	6	9	8

Winter Months 33
 Summer Months 26
 Unknown 8
 Total 67

SAKURAJIMA.

This is a large steep island, 3,500 feet in height. It is situated in the centre of Kagoshima bay, and its circumference is about 42,690 yards. On the southern side of it there is Okino Kojima; on the south-west, Torishima; on the north, Shinshima.

The peak of Sakurajima is divided into two parts; the northern and southern. The northern is an extinct volcano. It is so precipitous that it cannot be visited. The southern is an active volcano which is a little lower than the northern peak. Its crater is concave, like a very large valley. It is somewhat like Hachiyōmine on Fujiyama. On the north east side of it there is a crater, which is always sending up flames. On the southern foot there is an extensive hill, called Hakidashi. It was in eruption in the eighth year of Anei (1779). In the south-east of this island, there are four hot springs. Those in Furuzato-mura boiled up suddenly in the eighth year of Anei (1779); after this one spring ceased. Now only one spring remains. In Kurokami-mura, there are two more springs. These four hot springs are situated on stony ground upon the shore. They change their places according to the height of the sea.

The most recent eruption which took place was in the eighth year of Anei (1779). In the book *Kyuki*, it is recorded that "from 6 o'clock p.m. of the 21st day of the 9th month to 10 o'clock a.m. on the 1st day of the 11th month, the earth quaked and flames came out in Shirahama-mura and Minami Daira-mura." The fire was not extinguished for more than sixty years. When it was very violent, it sent out black smoke and was continually roaring and trembling. It also threw up a great quantity of large stones and they struck against each other as if they were lightning or stars of fire. So many persons and animals were destroyed or severely wounded at the foot of this peak that the sight of the mountain was painful.

Afterwards, 11th April, 1781, an eruption took place and

the people in the island were greatly frightened. They swore an oath to the god of the mountain and used to cease from the fishery on the 18th day of every month. This day they keep very quietly and pray to the god to purify their bodies. This prayer was called Toki, and it was not neglected for more than one hundred years. In time the flames gradually became less. Now when the weather threatens for rain, a little smoke will rise up. It is said by the people in the island that it sent up a little more smoke than now at the end of the winter of the 11th year of Meiji (1878) and very much more in the 3rd month of the 12th year (1879).

The most ancient writings say that in the 2nd year of Reiki (716) in the reign of Gensho Tennō, Hakusan Gongen (a god) appeared, and in the 4th year of the same, Mukōjima (in Ōsumi) was formed. Zoku Nihonki (a history) says that in the 12th month of the 8th year of Tempeihōji (December, 764) there was a sound like thunder in the western part. On the frontier of Satsuma and Ōsumi, the lightning darted about and it was very dark with clouds and smoke. After seven days it became clear. In the sea of Shinni-mura in Kagoshima, three islands were formed and flames appeared. Sixty-two divisions of houses were destroyed and more than eighty people killed." The three islands were in the sea between Kirishima and Sakurajima, one of them however has disappeared and only two remain. They are known by the name of Kojima. The Zoku Nihonki says that "In the 6th month of the 2nd year of Tempei Shingō (July, 766), the new island made by the god in Ōsumi, shook terribly, but the people escaped. In the 2nd year of Ōjin (1498), flames were thrown up on the top of Sakurajima. In the 9th month of the 3rd year of Bummei (October, 1471), an eruption again took place. In the 4th month of the 5th year of the same (April, 1473), another eruption took place. In the 8th month of the 7th year of the same (September, 1475), flames again appeared. In the 9th month of the 8th year of

the same period (September 1476) it burnt again and a piece of land, the circumference of which is about 8,640 yards, was formed. Many people and animals were killed or wounded. In the 8th month of the 10th year of the same period (August, 1478) the level ground, about 30,240 yards wide, in Fukuyama in Ōsumi, became a desert by the accumulation of ashes.

On the 7th day of the 3rd month of the 19th year of Kanei (6th April, 1742) an eruption took place. In the 8th month of the 2nd year of Kan-en (September, 1749), the mount Taihei-zan in Sakurajima erupted violently. In the 8th month of the 6th year of Hōreki (August, 1756), a hot spring at Yokoyama in Sakurajima, gushed out. This spring has since disappeared. On the 13th day of the 4th month of the 3rd year of Meiwa (21st May, 1766), a great inundation took place from the top of Sakurajima. From the night of the 29th day of the 9th month in the 8th year of An-ei (7th November, 1779) to the 1st day of the 10th month of the same year (8th November, 1777), the top of Sakurajima was broken and much fire was seen. Eruptions have been rare in modern times. Mr. Shimazu ordered a learned servant of his called Yamamoto Seigi, to make a record of the eruptions and also he ordered a painter to paint views of the mountain. This record says that on the 1st day of the 10th month in the 8th year of Anei (8th November, 1779), Kagoshima and the provinces to the east, south and north were shaken violently, and the water in all the wells in the island boiled up, and the colour of the sea became purple. Soon after 2 p.m., flames were thrown up at two places on the top of Sakurajima. The more violently it burnt the more it shook. The clouds of smoke were dispersed as soon as they collected. They were like stormy waves or mountains with many peaks. They reached high up in the heavens and extended very far. In consequence of all this the stars were lost from view and a dragon appeared. The flashing of the flames was like fierce lightning, and the fire stones flew here and there like meteors. It seemed as if a thousand valleys and mountains were to be

destroyed and violent fires were to burn the heavens and melt a thousand rocks. The things we saw during the day and night were too strange to tell about. Those who saw these things hurt their eyes, and those who heard had to close their ears. After five days the flames became weak but the burning did not cease. Every 3 or 4 hours or every 2 or 3 days it burnt and roared. At a distance of 13 or 15 miles to the south-east, flames were thrown up from the bottom of the sea. It roared violently both day and night, and many islands were created. These islands were 200 feet above the water, and their circumference was one mile and 500 yards. After a month things became quiet, but the shape of Sakurajima had changed greatly. Places which before were elevated became level, whilst those which were level became elevated. The scenery which we were wont to see was changed. At first, when the people saw the eruption they could not seat themselves for fear, and to eat became unpleasant. They escaped with their baggage on their backs, and with their children and parents in their hands.

Besides the above there were several other reports. One of these says that "violent flames have been sent out of the mountain; fire stones have fallen down; a great inundation is about to come; the mountains are about to be broken." Not long after this, ashes fell in quantity and all things became white. They entered doorways, floated in the air, and were heaped up on the mattresses, on the dishes, and on our food. Those who walked along the road opened their umbrellas or put on broad-brimmed hats, but it was impossible to protect the face and eyes.

In the villages, Taramizu, Ushui, Fukuyama, etc., ashes fell in immense quantities and covered the fields. Many large stones were thrown out and people and animals were killed or wounded. On the surface of the sea for more than 25 miles, across the straits, light stones were piled up to the thickness of 5 or 6 feet, and it was possible to walk over to the opposite

shore, whilst the progress of ships was stopped. The disturbances at Sakurajima have been ten times more violent than at other mountains. In the houses it was like in Isako, and out of doors it was like being on the sea. When persons laid down they were rolled about and when they stood up they were knocked over, and when they sat down they were inclined. When the flames began to show themselves, the falling of stones was like hail, and they were quickly heaped up to the thickness of 500 or 600 feet. The falling of ashes was like rain and they accumulated immediately to a thickness of about 30 fathoms. Birds had their feathers broken, and animals were wounded on their feet. On every side it was very dark with smoke and falling dust, and it was difficult to distinguish things around. Some of the inhabitants were crushed to death, some were wounded, some were buried alive, and some were burnt to death. Those who escaped were fatigued or starved amongst the mountains. Deer escaped to Yoshinoyama by swimming across the sea. After it became a little quiet, when the houses were examined, it was found that more than 140 persons had been killed. When the dead bodies were examined, some had their heads burnt, some had their side bones broken and some were torn in pieces. It was really a miserable spectacle."

During the whole of this time, Kishiū, Ise, Shima, Owari, Mikawa, and several districts in the east became dark, and ashes fell there frequently. On the 10th day of the 10th month ashes fell in Yedo. At that time it was very cloudy, and not unlike a white fog. Speaking generally, it was difficult to see each other, and one could not go out because ashes entered the eyes. In Ōsaka also ashes fell, and on the shores of Inaba, Hōki, Tajima, and Tango light stones were heaped up. On the 5th day of the 1st month of the 9th year of Anei (9th February, 1780), water gushed out from the top of Sakurajima and many people were drowned.

This sort of thing usually takes place after an eruption. On

the 11th day of the 8th month of the same period (9th September, 1780), it burnt greatly, and on the 4th day of the 10th month (31st October, 1780), it also burnt. On the 9th day of the 12th month, many islands were formed in the sea to the north-east. Mr. Shimazu ordered his learned subject Shirowo Kokuchyū, to make the Ōsumi-kai Shinsho Yoshutsuki (A record of the creation of many islands in the Ōsumi-sea).

On the 18th day of the 3rd month in the 10th year of Anei (11th April, 1781) Sakurajima again burst forth in eruption. On the 7th day of the 8th month in the 3rd year of Temmei (3rd September, 1783) it sent out flames, and ashes fell as far as Kyōto. On the 5th year of the same period (1785), it again erupted. On the 18th day of the 6th month in the 2nd year of Kansei (29th July, 1790), the top was much shaken and flames came out. On the 14th day of the 8th month in the 3rd year of the same (11th September, 1791), it again burnt. In the 6th year of the same (1794), it erupted. In the 9th year of the same (1797), it sent out flames. On the 22nd day of the 2nd month in the 11th year of the same (27th March, 1799), it sent out flames. In the 2nd month of the 7th year of Ansei (February, 1860), the Yamanoyu (hot spring) in Takakumanosato, in Ōsumi, and another on the shore of Tobioka, in Tarumidzunosato, gushed out. In the 9th year of Meiji, a hot-spring in Shin-mido-mura, in Ōsumi-gori, in Ōsumi gushed out.

Dr. Naumann says that Sakurajima was formed during one night in the 2nd year Yoro (A.D. 718).

SAKURAJIMA.

A.D.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Un- kn'wn
716													—
718													—
764													—
766							—						—
1470													—
1471											3		—
1473				—									—
1475									12				—
1476										27			—
1478								—					—
1498													—
1641				6									—
1742				6									—
1749													—
1756								—					—
1766					21								—
1779											7		—
1780									9				—
1781				11									—
1783									3				—
1785													—
1790							29						—
1791									11				—
1794													—
1797													—
1799			27										—
1860		—											—
Total	0	1	1	4	1	0	2	2	5	2	2	1	6
	2		5			9			5				
	Winter months										7		
	Summer months										14		
	Unknown										6		
	Total										27		

HIRAKIKIYAMA OR KAIBUN.

It is recorded in the history, Jindai Koteiki, that "in the reign of Itoku Tennō Hirakikiyama in Satsuma was created." This is the most ancient record we have of volcanic eruptions (184 years after Jimmu Tennō). It is recorded in the Hirakiki-Jinja-Engi (the record about the Hirakiki temple) that "on the 3rd day of the 10th month in the 20th year of the reign of Keiko Tennō, this mountain was created in one night." (750 years after Jimmu Tennō). It is recorded in the history Sandai Jutsuroku that "on the 2nd day of the 7th month in the 16th year of Jōkan (17th August, 874), there was an earthquake, and the Dazaifu (the government in Kyūshū) sent in a report that on the top of Jushiino-Jo-Hirakikiyama, in Satsuma, flames were thrown up and smoke filled the heavens. The falling of ashes was like rain, and the sounds

caused by the shaking could be heard at a distance of 300 miles. The farmers living near this temple lost their spirits by fright.

An augur said that "all this has happened because some people defiled him." After this 2,000 *ko* of land was immediately presented to him.

It is recorded in the Sandai Jutsuroku that on the 20th day of the 3rd month of the 2nd year of Jōkan (14th April, 860), to the Hirakiki god was added the rank Jushiinoge, "and it is recorded in the Ryūshū-kokushi that on the 7th day of the 4th month in the 8th year of Jōkan, the Hirakiki god was added to the rank Jushunojo," and also it is recorded in the book Shinkaishin that "in the 10th month of the 6th year of Genkei (November, 882), to the Hirakiki god was added the rank Shōshinoge." These were all added at the times when eruptions took place. It is also recorded in the Sandai Jutsuroku that "on the 9th day of the 10th month in the 1st year of Genna (29th November, 1615), the Dazaifu sent a report that "from the 6th month there was no rain in Hizen, and the governor presented the Nusa (cut paper) to the several gods and many priests read the sacred books. On the 13th day, the night was very dark, a sound of thunder was heard and sand fell. All the weeds and trees were dried up. Suddenly, however, it rained and they were restored to life. On the 12th day of the same month, the night was very dark and the stars were not seen. At this time stones and gravel fell like rain. By examining old books it was discovered that "when the Hirakiki god got angry, events like these took place. After this the governor cleaned his body and presented the Nusa (cut paper). The falling of the sand ceased shortly after. On the 11th day of the 8th month the sound occasioned by the shaking was like thunder, flames were violently thrown up, gravel covered the ground, and the day time was like the night. On the 12th day, from 8 o'clock a.m. to 12 o'clock in the night, the thunder roared and sand continually fell. The ground was covered with sand to a thickness of from 5 or 6 inches to 1 foot, and the people were in confusion.

Accounts of eruptions occurring on this peak cannot be found in books which were published after the 1st year of Genna (1615). For this there is good reason. Once Mr. Aoe went up Hirakikiyama and also several other peaks, and he found that the whole body of Hirakikiyama, which was once desolate, is now covered with weeds and trees, and the districts, Eikei, Kajitori, Kyurei, &c., are generally fertile, and to cause this change it must have taken many ages.

HIRAKIKI DISTRICT.

In Eikeigori there is a mountain called Shirakiki, which stands alone at the southern-most end of Satsuma. It has the form of a peninsula and its three sides project seawards to the south, but the northern side only joins level land. Its circumference is 14,880 yards and its length from the top to the foot is 4,500 *ho*. In the *Kojiki* it is called Kamokutokushima. The Emperor in the 2nd year of Jōkan (860 A.D.) ordered that the god of this mountain, whose title is Shō-Shi-ino-ge Hirakiki-no-Kami, should be worshipped. This mountain was originally in the centre of the volcanic region, and in old times it sent out flames with great violence. Very many of the neighbouring districts were deserted, and the three districts, Eikei, Ibusuki, and Kyuri, were much distressed.

From the appearance of the present craters, arranged like a hive, and from the hot springs which are scattered about in the two districts, Eikei and Ibusuki, it is thought that the eruptions in ancient times must have been extraordinarily violent. These eruptions have now been stopped for more than one thousand years. The ashes and the sands have been gradually changed into fertile land, and the whole mountain is covered with woods, so that bare rock or earth is not to be seen. In this latter respect it differs from Sakurajima and Kirishima, &c., which are bald. The woods in the lower part of this mountain are cherry and pine. In the upper part, there are evergreen trees. On the top, there are only boxwood

and sakaki trees, &c. These are very small. On the top and just below it, there are clear springs which gush out with great force. It is supposed that these springs were produced by the water-puddle which in ancient times was the crater. The top is level, but it is not more than 100 *ho* wide. The southern part of it is low, but the northern is very high. The old crater is filled up with rocks and stones, and traces of the ancient fires are not visible. There are many dikes, ponds, caves, and valleys which belong to this peak. The largest of these are the ponds of Ikeda, Unagi, Ikezoko, Narikawa-mura, Yamagawaminato, Kagami and Mizunashi, &c. The lake Ikeda is also called Hirakikino-Miike. The people say that "it is the ruins from which Hirakikiyama used to gush out, and it is just like the lake Biwa on Fujiyama." Its circumference is 19,640 yards, and the depth is not measured. The pond Unagi is at a distance of about 120 yards to the north-east of the Ikeda lake, and the circumference of it is more than 4,320 yards. Narikawa was originally a pond, but in old times one part of it opposite to Yamakawa-minato was open and the villages which are situated there were built. Yamakawa-minato's circumference is 4,320 yards, and in ancient times its entrance was very narrow and not easy for ships to go out or come in. It was therefore subsequently widened. Its shape is like an ancient crater. Many hot springs gush out along its shore. Kagaminoiki has a circumference of 600 yards and a depth of 9 fathoms. At the bottom there are many dead trees. The ground is said to have sunk in Mizunashi-ike, sometimes called Furu-ike. All of these ponds were made by volcanic action. There are a great many hot springs connected with these ponds. In Yamakawa pond, there are three springs, and at Ibushi twelve. At Unagiyu and Yunomine there are two springs, and these are very hot. Unagiyu, which is at the foot of the cliff on the north of Unagi-ike, boils up and roars like thunder and never ceases day or night. The people call it hell, and they use it to boil their potatoes and turnips. Yunomine, which is at the back of Unagi-ike, sends up

smoke which, from a distance, looks like a white cloud. It cannot be approached. In Imaizumi, there is no hot spring, but there is a village called Onsen (hot-spring) and therefore it is supposed that in olden times hot springs were there.

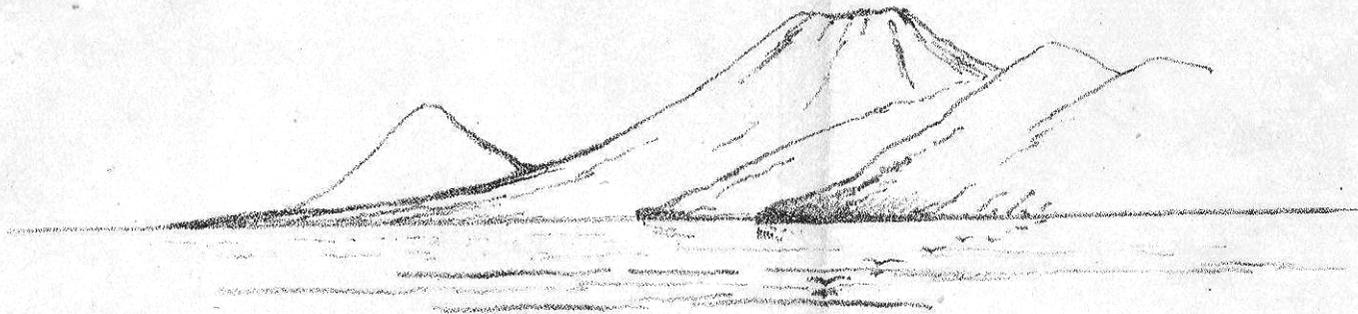
HIRAKIKI-YAMA.

	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Un-known.	
B.C. 510	Mount. formed.
or A.D. 71	Mount. formed (another acct.).
860	14	.....	.....	.....	.....	.....	.....	.....	.....	.....	Eruption.
866	20	.....	.....	.....	.....	.....	.....	.....	.....	Eruption.
874	17	.....	.....	.....	.....	.....	Eruption.
882	—	Eruption.
1615	Eruption.
	—	—	—	I	I	—	—	I	—	—	2	—	I	

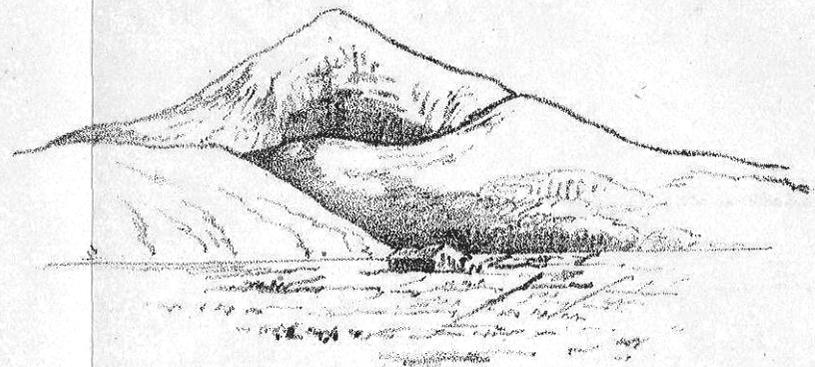
ONSENDAKE.

Another line of volcanoes cross the above line, in the centre of Kyūshyū and make the form of a cross. In the centre of it is situated a volcano called Onsendake. On the side of this volcano there are many springs, the largest of which is called Ōjigoku (great hell) and the small one Kojigoku (small hell). Ōjigoku emits boiling water and roars violently, as if a hundred thousand kettles were boiling over. Ascending about 4,320 yards from Ōjigoku you reach the top called Fuken. Before the great eruption in the year of Kansei (1789 to 1800), there were one hundred and thirty-six Jigoku (hells), which, day and night, boiled up and caused the ground to tremble, after this they ceased to boil. On the shore at the foot of this peak, there are everywhere many springs called Yumoto.

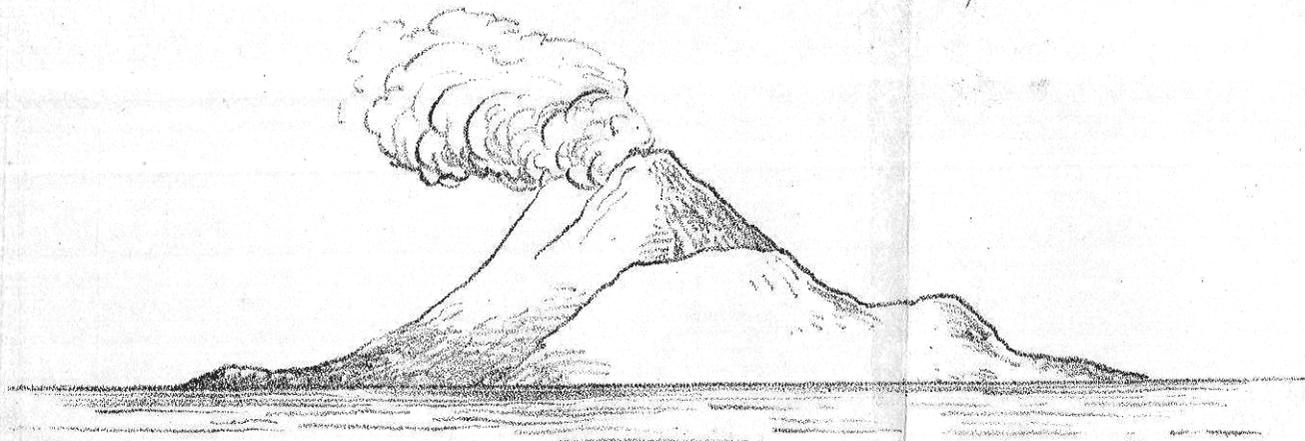
Onsendake, or Unsen (*Fig. 1 Plate I.*) in Takunogori, in Hizen, has been a volcano from ancient times. In the year of Wado (708 to 714) it was minutely described by the Mikado's order. This description is in the Hizen Fūdoki (Topography). This Fūdoki says that an ancient Tennō, who lived in the Hishiro palace in Motomuku (name of a place), went to Nagaohama in Tamanagōri



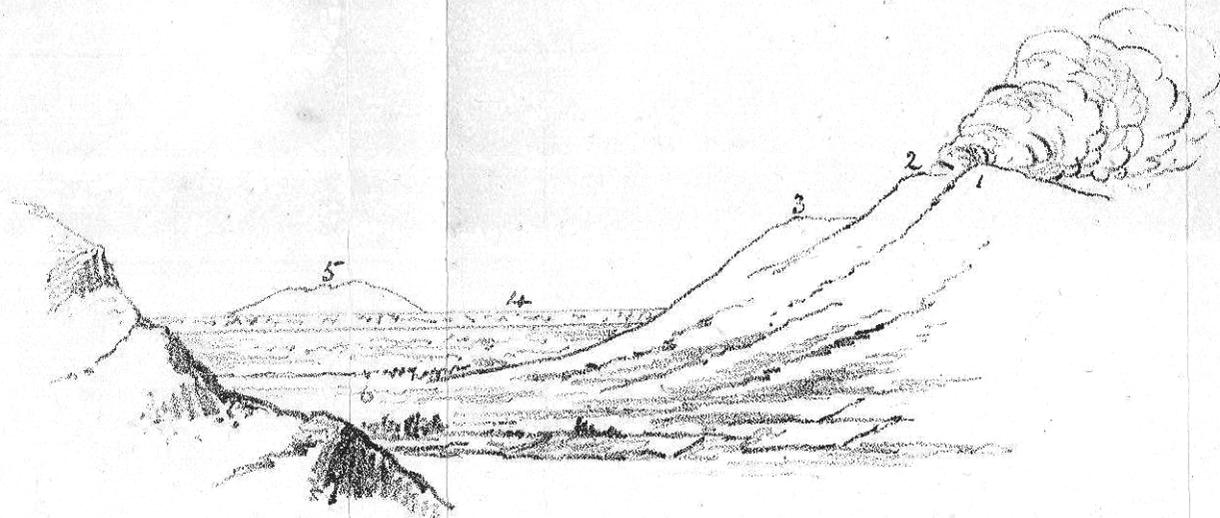
1 Unsen from the West.
(from other sides it is irregular)



2 Kuratake.



3 Awogashima



1. Dobindake 2. Aosan 3. Nekodake 4. The Ring wall
5. Sudake 6. The Crater plain, with villages, fields, trees &c.

Plate 1.

in Higo, and saw this peak, and said "that peak is like an island. Is it a peak or an island? I should like to know." Immediately he sent one of his subjects, Ononosukune, to examine it. A man came out to meet this messenger and said, "I am the god on this peak, Takutsui, and I have come out to meet you because you are the Mikado's messenger." Therefore this place is called Takunogōri. The hot-spring called "Mine" is in the south of this. Kōri, and its source is in the south-western part of Takunomine. It runs with violent speed to the eastward and its heat is very different from the others. It can not be bathed in unless cold water is added, and it tastes sour. On this peak we find sulphur, white clay, and pine trees. The leaves of the pine are five, and the fruit is like a small red bean. In a place called Ohamura, at a distance of about 8 miles west from Shimabara Castle, in Takunogōri in Hizen, there is a high mountain. In a low place on the western side of this is a hot-spring called Onsenzan. The top of the hill above this is called Fukendake. Every morning from the beginning of the 11th month of the 3rd year of Kansei (November, 1791), a great many sailing vessels, each sail-cloth of which is about 17 or 18 *tan* (a *tan* is 26 feet) appeared in the air on the peak of Fukendake. Similar things have been seen in other places. Some time ago, the mount Komagatake in Yezo threw up flames. Some days before that the people of Matsumaye saw, every day, the bodies of the gods and Buddha flying about in the air, and soon after Komagatake blew up, and a great inundation swept along the Mastumaye coast. The people of Takunogōri had strange thoughts about this vision. On the evening of the 7th day in the 1st month of the next year (30th February, 1792) three or 4 fires, the circumference of each of which was about 5 or 6 feet, fell down near the temple Ichijōin in Onsenzan. From 10 p.m. on the 18th day of the same (10th February, 1792) over eight-tenths of this peak, two fire pillars were standing for about two hours. All who saw them had great fear. From 6 p.m. of the 2nd month,

Fukendake began to shake and to give forth sounds. It was as violent as one hundred thousand thunders. The level land shook greatly and sand and stones fell like rain. When seen in the morning, the upper part of the peak was wrapped in cloud and smoke, and was shaking violently. At this time, on the top of Fukendake, ground to the extent of about 6,000 yards became very low, and at the centre of it, two craters, the diameter of each of which was 6 or 8 yards, were made. From these craters flames and sand and ashes were thrown up. Besides these there were more than 50 other burning caves upon this peak. When it was looked at from a distance it seemed to extend for more than a mile and a half. In the 3rd month, Kyūshū was shaken violently. When the shaking was most violent it was shaken 45 or 46 times in a day.

In the mountains in Miai-mura, which are continuous with Fukendake, there is a valley called Anasako. On the 1st day of the 5th month, it shook violently in this place, and sand and stones fell down. On the 6th it became more violent, and the sand and stones began to be heaped up. From a place called Hachinokubo, which was opened on the 29th day of the 2nd month, flames came out. Several peaks near to this were all broken down. As the burning of Anasako continued it gradually became low, and approached the houses of the people. From the 1st day of the 3rd month, it shook violently and at midnight the sounds became very fearful. A high mountain, called Maeyama, which is near to Fukendake and Shimabara Castle, was suddenly rent from the top to the foot. At 6 p.m. on the 6th day, it shook violently and the flames issued from the sea of Shimabara like many meteors. The people doubted that there could be a fire in the sea. On the 1st day of the 4th month, several towns and seventeen villages in Shimabara were inundated and large pieces of timber and stones were swept away. The people who were drowned were more than 27,000, and the ships which were lost were more than 400, and with them also a number of

persons. The three islands which were created in ancient times were swept away. Maeyama, which is in the neighbourhood of Fukuzan, erupted, and lava from the top ran down to the foot and out into the sea. Many islands were formed in the sea at a distance of about 4,320 yards from the shore. At a distance of about 1,200 yards to the south of Shimabara Castle, a long peninsular jutting into the sea was formed. Its height was about 60 or 70 feet and its length was about 4,320 yards. At this time the district round Shimabara was very hot. People could not walk in their straw shoes, and flowers opened prematurely. The destruction on the 1st day of the 4th month, extended as far as Tamana, Udo, Masuki, and Akuta, in Higo, on the coast opposite to Shimabara. They were inundated about 7 p.m.

The height of Onsen is about 4,100 feet. Titsingh says that in 1773, 53,000 persons perished. From the present appearance of Shimabara it would seem that the formation of a peninsula and islands and the destruction generally in 1773, was chiefly due to a landslide. It seems to have been smoking in the time of Kämpfer.

TSUMURIZAN.

Tsurumizan is to the east of Asozan, and is situated in Kaibegōri, in Bungo. In Kaibegōri there are many hot springs and boiling water gushes out everywhere. Tsurumizan is the highest mountain in Bungō. When the weather changes it emits smoke. At the foot are many very hot springs called Jigoku (hell). That which is called Konya-no-Jigoku (dyer's hell) is of a blue colour, and that which is called Chi-no-Jigoku (hell of blood) is of a red colour.

Besides these there are Aburaya Jigoku (hell of oil shops), Sakaya Jigoku (hell of wine shops), etc. Amongst these is one called Ike-no-Jigoku (hell of pond), which seems like a boiling kettle. The people in this island use it to boil their vegetables in.

Sandai Jutsuroku says that "In the 16th day of the 2nd month of the 9th year of Jokwan (25th March, 867), Dazaifu (the government of Kyūshū) reported that in Tsurumiyama, in Hayamino Sato, in Bungo, there are two gods, Jugoijo Hino Ogami and Jugoige Hino Megami. On the top of this mountain are three ponds. The water in the first of these is blue, the second is black, and the third red. On the 20th day of last Shōgatsu (first month) this pond shook and roared like thunder. Soon after there was a smell of sulphur which was felt over the surrounding country. Many rocks flew into the air. The largest of these were about ten cubic feet and the smaller ones like bricks. During the day black clouds ascended and during the night flames were seen. Ashes covered the ground like snow. The road at the foot cannot be traversed. The water runs into many streams and many fish have been killed. The shaking and the sound has lasted for three days."

KIRISHIMA-YAMA

Kirishima-yama is the central mountain of the southern part of Kyūshū. It extends into two provinces (Ōsumi and Hyūga), three towns (Morokata, Kuwabara, and Suō), and twelve villages. It has many peaks. These are called Higashidake, Nishidake, Yadake, Nakadake, Shishidake, Iinoōdake, Hinamoridake, Meshimoridake, Yahazudake, Kurinodake, and Shiradoridake.

Nishinodake is the male mountain and Higashidake is the female, but all others are the child mountains. Higashidake is an extinct volcano. It has a height of ten *cho* forty-eight *ken*. It was on this that in ancient times our heavenly grandson (Niniginomikoto) descended. Nishidake is a very precipitous volcano. It is sometimes called Hitokonome. It is somewhat higher than Higashidake, being 1,392 yards. On the upper part of this mountain there are no trees, it being covered with white sand and ashes. When looked at from a

distance it appears just like a snow mountain. Its appearance is described in a book called *Koshi Kan Yōki* as follows :—

“Intending to see the well of fire, I started off. The people of this place call the well Mi-ike. On my way I lost my guide, and in consequence did not know which way to go. Seeing smoke in the west, I went towards it. When I came near I saw formidable black smoke and flames like red dragons rising out of the mountain. The circumference of the pit, which is on the ridge of Nishidake, is about five hundred *ho*. Its depth is not known. Its waters, which are boiling, are of a white or bluish colour. It makes an extraordinary sound like thunder and large stones are shot out of it.”

There are many old craters, belonging to this mountain (Nishidake). Many of these are now ponds or marshes. They are named the forty-eight ponds of Kirishima-yama. These ponds are generally in the ruins of old craters. There are more than twenty hot springs belonging to this mountain.

Kabayama Suketsuma says as follow :—“Some people think that from ancient times this mountain has very frequently been in eruption and many peaks have been destroyed. In the time of the kami there were two mountains called Futakaminomine, which stood with Higashidake and Nishidake. It is supposed that these were destroyed by volcanic eruption. To the south of Higashidake there was, in ancient times, a mountain called Kakifunomine joining on to Takachihonomine. It was always in action, until at last its top fell away. Now it is called Hiana and Mihachi.

“To the south, not so far from Nishidake, there is Ōnami-ike, which is supposed to be the ruins of a large mountain. Before the top of this mountain was destroyed, it was standing side by side with Nishi-dake. In ancient history, it is therefore called Soeyama.”

The history *Zoku Nihonki* says that in the 11th month of the 14th year of Tempei (December, 742), the governor of

Ōsumi reported that "from Hitsujinokoku (2 o'clock p.m.) of the 23rd day of this month to the 28th day (24th December to 29th December, 742) there was a sound in the air like a drum; the pheasants were frightened, and the earth quaked violently.

On Heün (the name of a day) a messenger was sent out to examine the facts and to hear the commandment of the kami. There is no name given, but it would probably be Kirishimadake. Also in the 7th month of the 7th year of Enreki (August, 788), the Dazaifu reported that from 8 o'clock p.m. on the 4th day of the 3rd month, on the peak Sono, in Suōgōri, in Ōsumi, flames rose up but at 10 o'clock p.m. only black smoke rose up. After this black sand fell to a thickness of two feet covering an area of 21,600 yards."

From a book called Shuzanki, which was published by Ijichi Sueyasu, it appears that since the eruption in the 7th year of Enreki (788 A.D.) the eruptions continued through Daido (806 to 809), Kōnin (810 to 823), Tenchō (824 to 833), Shōwa (834 to 847), Kashō (848 to 850), Ninjn (851 to 853), Saiko (854 to 856) and Tenan (857 to 858). The temple of Kirishima in olden times was situated in a place called Hakumonga-oka. It was built by a priest called Kei-in, in the reign of Kōmei Tennō, but after two hundred and fifty years it was burnt by the eruption of Enreki (782 to 805) and people ceased to worship there for nineteen years. In the 8th month of the 4th year of Shōwa (September, 837) the Kirishima god was claimed by the government. It was situated half way up the peak. Afterwards in the 6th year of the same period (Shōwa) the burning still continued. In the 9th month of the 10th year of Shōwa (September, 843) the rank of Jugoige was given to the god. The fire did not cease until the 15th year (848) and then the rank of Jushiijo was granted to the god. Afterwards, in the 8th month of Tenkei (938 to 946), Seiku, a priest of the Tendai religion went up this peak and stopped there five days, but the god's fire continued. There-

fore he escaped to Hakumonga-oka and made a hut at the western foot and lived there for 4 years. In the 3rd of the 2nd month of the 3rd year of Ten-ei, (1st March, 1112), the mountain shook and emitted fire. In the 2nd year of Nin-an (1167) it was in eruption. In the 12th month of the 1st year of Bunreki (December, 1174), a violent eruption took place and the strange spring called the Ten-no-ido (well of heaven) dried up. In the 2nd year of Taiyei (1522) the hot spring of Anraku, in Kirishimayama, broke out. In the 4th year of the same (1524) there was an eruption. From the 23rd year of Temmon to the 9th year of Meiwa (1554 to 1772), great eruptions took place more than ten times in a period of 230 years. In the 9th year of Yeiraku (1566) it burnt fiercely. In the first month of the 2nd year of Tenshō (January, 1574), the top of the mountain shook violently and flames rose up. In the 10th month of the 13th year of the same period (1585), it again shook and sent forth fire. On the 17th day of the 4th month of the 15th year of the same period (24th May, 1587), it sent out flames, and shook. White clouds floated above the black smoke, and the flames rushed up to heaven, three or four times a day. From 4 o'clock to 6 o'clock on the 12th day of the 3rd month of the 16th year of the same period (7th April, 1588), the mountain shook violently. In the 2nd year of Meireki (1656), the pond of Taizozakai dried up and large trees were seen in it. In the 5th year of Tempo (1677), an eruption took place. On the 9th day of the 1st month of the 6th year of the same period (1st March, 1678), it burnt. In the 12th month of the 2nd year of Hōei (January, 1706), an eruption occurred. On the 26th day of the 9th month of the 1st year of Kiyoho (9th November, 1716), an eruption took place and on the north side of the top and at two places on the shore of the pond, the ground fell in. In the 1st month of the 2nd year of the same period (February, 1717) it again burnt fiercely. Afterwards for three or four years ashes continually fell, and the fields at the foot of the mountain were covered to a depth of five or six feet. Also, at

times, large stones were thrown out and many people and animals were killed or wounded. More than 600 houses were burnt and 400 animals killed. In the 9th year of Meiwa (1772) it burnt again, and the houses and fields in several parts of Hyūga suffered severely.

KIRISHIMA-DAKE.

	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Un- known.	
742														Eruption.
788														Eruption.
806														
809	between													Eruption.
810														
823	"													Eruption.
824														
833	"													Eruption.
834														
847	"													
848														
850	"													
851														
853	"													
854														
856	"													
857	"													
858	"													
1112			I											
1167														Eruption.
1174														Eruption.
1524														Eruption.
1554														
to 1572														Ten Eruptions.
1566														Eruption.
1574														Eruption.
1585														Eruption.
1587					24									
1677			I											Eruption.
1678														Eruption.
1706														Eruption.
1716											9			Eruption.
1717														
1772														Eruption.

ISLANDS IN THE SEA OF SATSUMA.

In the sea to the south, at a distance exceeding 43,200 yards, there is an island called Iwogashima (the island of sulphur). It is one of the many islands, belonging to Kawabegori in Satsuma. It is also called Kakaigashima (island of devils), Okinokojima (island of yellow sea), because the sulphur is mixed with the sea-water and gives to it a yellowish appearance. It is distant 77,760 yards from Yamakawaminato, 43,200 yards from Kuroshima, 12,960 yards from Kuchino Yerabushima in

the south. Its circumference is 77,760 yards and its diameter from east to west is 4,320 yards and from south to north 2,160 yards. Iōgamine (the peak of sulphur) lies on the north-east side of this island and its height is about 2,160 yards. On the upper part of it, much sulphur is burning. Its top is hollow like a pond. It is 8 or 10 yards deep, and the diameter is about the same as the depth. The smoke from the burning sulphur in this crater is like the smoke from the chimney of a steam-engine. The sulphur which has been burnt in holes and crevices of the rocks adheres everywhere and appears like rock. The sulphur-vapours which rise up into the air with the smoke, fall down like rain both day and night. In consequence of this the plants at the foot of the mountain have a white colour. The sulphur water runs into the sea, and the sea-water becomes in consequence of a yellow colour. Inamuradake and Monakusadake, which were originally the peaks of one mountain also give out much sulphur. The mountain range to the east of these is called Yahazudake. At the foot of the Monokusadake there is the river Monokusagawa, which is always dried up excepting when it rains for a long time.

This island is almost destitute of clear springs, there being only one well on the eastern side. Its depth is about 10 feet and the quantity of water is small. It is always warm. On the south side of this island there is one hot-spring which gushes out 4 or 5 feet above sea-level, and immediately runs into the sea.

The eruptions of this peak are very ancient and are not recorded. It is thought that it was burning more than one thousand years ago.

At a distance of 117 miles and 144 yards from Kagoshima is the island of Yaku which lies to the south-east of Iōgashima. It has a circumference of 108,000 yards. In old times it was once called Giyomugōri. In the centre of it is Yaegakidake. The highest mountain of all is Miyauradake. This is six thousand feet above sea level. Around it are situated many peaks which are like children around their parent.

Along the shore to the south-east, there are many hot-springs. Amongst these the largest one is in Ōnomamura. It is very strong and gushes out from holes in the rocks. The next is Heinai which gushes out at a number of places on the shore. Besides these, there are countless other springs.

On the northern part of this island, there is no appearance of a volcano. In the southern part there is a hot spring. In the south-east, there is a deep pond called Sokonashi-ike (pond without bottom) of Hanaye-gawa. These facts appear to tell us that in the south-east there was once a volcano and that Sokonashi-ike was the crater of it.

At a distance of 43,200 yards to the north-west of the island of Yaku, is Kuchino Yerabushima, which is so called because it is the first of seven islands. Its shape is just like a melon floating on the water. The western part is its head and the eastern its tail. The diameter of this islet is 960 yards, and exactly in front of it there is a place called Motomura, where are the ruins of villages, covered with sand and ashes thrown up by eruptions in olden times. The island is a volcano and has several peaks. Moedake is the peak at present active. The height of it is about one thousand and eight hundred feet above the level of the sea. In olden times it was burning on its summit and was very violent. At present it burns on its side and appears to be gradually ceasing. At the eastern foot of Moedake, there are many boiling springs. At a distance of 21,600 yards to the southwest of Kuchino Yerabushima there is Nakanoshima 169 miles and 640 yards distant from Kagoshima. It is in the centre of the seven islands and has a circumference of 19,430 yards. The highest peak in this island is Moedake which is always burning. There are two rivers here, one called Tsukurikawa and the other Koromokawa. At a distance of 345,600 yards from Kagoshima and 21,600 yards from Hirashima is situated Suwanosejima, sometimes called Moeshima. It has a circumference of 12,960 yards. It has been continually burning from olden times.

When, in the 10th year of Bunka (1813), its eruptions were most violent the people could not remain on the island. No people live there now.

FORMATION OF ISLANDS IN THE SATSUMA SEA.

Sakurajima was formed in A.D. 718. Two small islands near Sakurajima were formed in the year of Bundzi 1185-1190. On the 9th day of the 12th month (1780), many islands were formed in the sea to the north-east. Mr. Shimazu ordered his learned subject Shirowo Kokuchyū, to make the *Ōsumi-kai Shinsho Shoshūtsūki* (A record of the creation of many islands in the *Ōsumi-sea*). At this time also the island called Inokojima, which has a circumference of 480 yards, was formed. During the night of the 9th in the 12th month of the 9th year (3rd January, 1781), another island was formed. It was called *Iōjima* because it smelt of sulphur. On the 8th day of the 4th month of the 9th year (11th May, 1780), two islands were in close proximity, but on the 5th day of the 5th month (7th June, 1780), they were connected and became one island with a circumference of 360 yards. This was called *Anejima*. On the 11th day of the 6th month (12th July, 1780), another island was formed, and on the 2nd day of the 9th month (29th September, 1780), another formed, and on the 3rd day of the 10th month (30th October, 1780), another. Two of these were very small and afterwards they were joined together and became one. This was continued until it joined one which was formed on the 11th day of the 6th month (12th July, 1780), and they were called *Ebisujima*, because they are very good for fishing. All the islands except *Ebisujima*, which is a heap of white sand like snow, were composed of rocks. On the 14th day of the 12th month (8th January, 1781), another island was formed, but shortly after it disappeared. The whole of these islands are called *Anejima* because they were formed in the year of *Anei*.

On the 12th month of the 8th year of *Tempei-hōji*, in the

reign of Haitei, (December, 764), three islands were created in the sea off Shinji village, in Osumi. The islands which have been created in the seas around Japan are innumerable. As islands have been formed so often, the old government (Tokugawa Shōgun) ordered Mr. Matsumae (Daimiō in Hakodate) to give a report about Yezo and its islands. Mr. Matsumae presented three reports, in which there are accounts of earthquakes, the creation of islands and high mountains. From these reports it is clearly shown that in Yezo some high mountains were created.

ISLANDS IN THE SATSUMA SEA

A.D.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Un-known.	
718													-	Sakurajima formed.
764													-	Three islands formed near Shinji.
1185													-	Two islands near above.
1190													-	
1780					11									Two islands formed.
1780						7								Above became one (Anyejima).
1780							12							Island formed (Yebisujima).
1780								29						Island formed.
1780									30					Island formed.
1781		3												Iwojima formed.
1781		8												Island formed but disappeared again.
1813														Suwanosejima. Eruption.
	2	-	-	-	1	1	1	-	1	1	-	1	3	

Amongst the islands which connect Southern Japan with Formosa, which are still active, we find the following:—

Iwoga-shima	2,331 feet high.
Yerabu-shima or Nagasobe	2,297 feet high.
Naka-shima	3,400 feet high.
Kaminone	972 feet high.
Yoko-shima	1,700 feet high.
Iwo-shima	541 feet high.

Marshall says that Suwase-shima and Tori-shima are also active. These islands with others form, on European charts, the Linschoten, Lew Chew, and Meiacō Groups.

On Okinawa, or the Great Lew Chew, the rocks are principally metamorphic rocks of tertiary age, and round the coast a coral formation.

Tai-pin-san, in the Meiaco Group, is chiefly coral limestone. Further south, on Pa-chung-san, we find metamorphic rocks, granite, andesite, and coral limestone. Ku-kien-san is chiefly tertiary, metamorphic, and coral.

From these notes it would appear that the volcanic character of this chain of islands is chiefly marked in the north, near to Japan.

FUJI-SAN.*

Of all the mountains in Japan, Fuji-san the *mons excelsus et singularis* of Kæmpfer, is the one which has been most written about. Not only do we find a vast number of native books describing this mountain, but every book treating of Japan which has been published in foreign countries, always finds occasion to mention the "peerless Fuji." In consequence of its height, the symmetrical curvature of its slopes, and its solitary grandeur, Fuji has become one of the most famous mountains of the world. Not only is this mountain an object of admiration to the European, but it obtains an equal if not greater share of admiration from the Japanese. We find representations of it in the pictures of the artist, and its name in the stanza of the poet. To the poorer class of Japanese it is analogous to what Mecca is to the Arabian, a Holy Place which must be visited before he dies, and every year from 15 to 20 thousand pilgrims toil slowly to the summit to pray to the Fuji Sengen (god).

The walls of the crater are in most places perpendicular, but here and there they have been broken down. The rim of the crater is very rugged. On the N.W. side there is a peak called Ken-ga-mine, and on the S.E. a peak called Kuma-ga-take.

When I ascended the mountain in 1880, small quantities of steam were seen to be issuing through the ashes on the eastern side of the mountain, just outside the lip of the crater. As Fuji-san is usually described as being quite extinct, this fact may be of interest.

* *i.e.* Mount Fuji. By foreigners often called Fuji-yama.

Like all mountains, especially those of volcanic origin, Fuji-san commences with a gentle slope which becomes rapidly steeper as we near the summit. The greatest slope is about 35° .

Dr. Rein, on the authority of Professor von Fritsch, and his assistant, Dr. Ludecke, describes the rocks of Fuji-san as dolerites.

On the south side of the mountain at a height of about 9,000 feet there is a small crater, the rim of which forms an excrescence on the regularity of the slope called Hoi-san. This was produced by the last eruption in 1707. A Japanese writer, referring to this occurrence, says that it was at this time that the wonderful mountain injured its beautiful form. This eruption is described at great length in a series of translations from the Japanese by Dr. E. Naumann in his paper on the earthquakes and volcanoes of Japan (*Transactions of the German Asiatic Society*, Part 15).

The principal rocks composing the hills which surround the plain from which Fuji rises, are andesites, tuffs, clay slates, granites, and other crystalline rocks.

An excellent general account of Fuji is to be found in the Hand-book to Central and Northern Japan by Messrs. Satow and Hawes.

These few remarks which I have made upon this mountain are only intended as a brief introduction to the following translation from the Wakan Sansai Dzuye, for which my thanks are due to the late Mr. T. R. H. MacClatchie, of the English Consular Service.

My object in giving this translation is not because it is by any means a full account of what might be written about this celebrated mountain, but it appears to be a note which may advantageously be added to the many other accounts which have been already published by previous writers. It runs as follows:—

The lands below Fuji-san are —

On the S. and W.	Sunshū (Suruga).
On the E. and N.	Sōshū (Sagami).
On the N. and W.	Kōshū (Kai).
On the S.E., it slightly enters ...	Zushū (Izu).

This celebrated mountain is without an equal throughout the three countries (*i.e.* Japan, China, and India) : in looking at it from any one of the eight barrier provinces, its appearance is never different. Its summit, being in the shape of an eight-leaved lotus flower, offers three peaks to the view wherever one faces it. Now, to explain its precipitous form,—if you take a folding fan of ten sticks, take in a single fold in its centre so as to make it appear one of nine sticks, and then turn it upside down,—its appearance will be then be just like that of the mountain.

NOTE.—If you view it from Hakone, it has five peaks; seen from Hara, there are four; and from Ejiri, three.

Tradition has it that Fuji-san first appeared to view in the 5th year of the Emperor Kōrei (294 B. C.) One night the earth opened, and a great lake was formed; this is the lake in Gōshū (Ōmi). The earth from this cavity became a huge mountain; the Fuji of Sunshū.

NOTE.—In the “Kokushi” and books of the same sort, the above is not stated, and it is not indubitably true.

There is snow on it throughout the four season, and smoke issues from its peak.

The Mikado mountain of Gōshū slightly resembles Fuji in appearance, on account of having been formed by the earth which dropped from the baskets [during transportation to Suruga].

The tale of Jofuku of Shin having entered into the Elysian mountain has reference to this same Fuji.

NOTE.—This was contemporary with the Emperor Kōrei.

After this, En Shōkaku first penetrated Fuji and made a road.

NOTE.—Although the mountain is said to belong to Sunshū, its temple entrance is on the N. side, in Kōshū. This is treated of in the volume on Sunshū [of this same work].

In the 1st year of Daidō (806 A.D.) the Emperor Heizei erected the first shrine on the summit of the mountain, and it is mostly ascended every year, in the 6th month, by persons who for the space of 100 days before have bathed in cold water

and fasted. The men of Gōshū alone ascend after a fast of merely 7 days,—this being by reason of their affinity to Fuji-san. There is on the mountain a great deal of sand, and by reason of men's footsteps this sand goes pouring down; in the night, on the contrary, the sand ascends to its former position. Throughout the whole mountain there are large numbers of *keyaki* trees.

“The fallen snow, collected at the base
 “Of Fuji's mount, no sooner disappears
 “Upon the Full Moon of the ‘Droughty Month,’†
 “Than, on that very night, again it falls.

Tono Yoshika, in his “Fuji-san,” says,—Fuji is situated in the province of Suruga. Its peak looks as it had been carved out, it rises aloft direct to the skies, and its height cannot be measured. In the guide-book it is written: “There is no mountain more lofty than this one. Its peak, ascending in gloom, appears, if you gaze upwards at it, to be on the very verge of heaven, and to look down on the very depths of the sea. If you observe its wondrous base, the circumference thereof extends thousands of *ri*; travellers take countless days to complete its circuit, and even when they leave it, on gazing back they seem again to be beneath the mountain. It is in all probability a haunt where deities and genii assemble to disport themselves.”

“When Heaven and Earth were separated, and men saw the mountain-peak of the lonely, lofty, and noble Fuji of Suruga descend from the expanse of the skies, the light of the sun was hid and the shining of the bright moon was not visible, and the white clouds also being arrested in their staying or passing on, the snow poured down. The mountain-peak of Fuji will pass down in tradition from generation to generation.”—(*The Manyō*.)

The *Giso Rokujō* says: “In the country of Japan there is, more than 1,000 *ri* to the north-east of the capital fortress, a mountain called Fuji, otherwise styled the Elysian Mountain.

† *Minazuki* i. e. *mizu-ga-nai-tsuki*, “Droughty Month,”—the 9th month.

This mountain is precipitous, on three sides it faces the sea ; it rises abruptly to its elevation, and from its summit there comes forth in the day time smoke and flame. There are on it many fine springs flowing down, these again ascend in the night-time. Sounds of harmony are always heard on it. Jofuku halted here, and named it Elysium, and to this day his descendants are all called the Hada family" [*Hada* is the Japanese reading of *Shin*, Jofuku's dynasty.]

When my lord Hideyoshi attacked Korea, Katō Kiyomasa made captive at Orankai a man whose name was called Serutōsu. He was from Matsumae, in Japan, had been carried thither by a storm, and had lived in [the province of] Seishū [Corea] for 20 years. Kiyomasa, in delight, made this man his guide, and changed his name to Gotō Jirō. Jiro stated that from that country, on a clear day, one could see Fuji-san very close.

On consideration, I think that the vulgar reports which say that the earth from Hako [Lake Biwa] became Fuji-san are falsehoods, for how could the earth be well transported thither when Suruga and Omi are separated by more than 100 *ri*? I should not wonder if the mountain had suddenly come forth, or if the sea had seethed up,—for in foreign countries, too, these things have happened. In the "Tōkoku Tsugan" it is written: In the 10th year of the Emperor Bokusō of Kōrai (a province of Corea), and in the 4th year of the period Keitoku of Gō, a mountain came seething up from the midst of the sea of Shinra in the South of Corea. When it first came forth, clouds and fogs being black around it, the earth was shaken, with a sound of thunder, for seven days and nights. When first the weather cleared up and became fine, the height of the mountain was rather more than 100 *jō*, and its circumference was slightly over 40 *ri*. There was neither grass nor tree on it, and a mist overhung its summit. If you looked at this mountain, it appeared like hardened sulphur. The professors of the Daigaku sent Den-kyō-shi to examine it, and he

drew a picture of its appearance as seen from the base, and this picture he presented to them.

Its summit burst forth spontaneously into flames from the 14th day of the 3rd month of the 18th year of the period Yen-riaku [799 A.D.], in the reign of the Emperor K'wamm, till the 18th day of the 4th month. In the day-time the smoke was dark and black, but at night fire showed out and lit up the heavens. The noise made by it was like thunder, and the falling of the ashes was as rain; the river and water at the base of the mountain became all of a red colour. *Vide* the *Nipon-kōki*.

In the 5th month of the 6th year of the period Jōg-an [864 A.D.] of the Emperor Seiwa, the mountain burned for a space of some 1 or 2 *ri*'square only. The height of the flames was 20 *jō*; there was thunder, and earthquakes took place three times. Even when more than 10 days had elapsed, the flames were not extinguished. They broke away the summit of the mountain, the sand and stones fell like rain, and a lake was formed on the N.W. side. The stones and sand from the burning portion filled up the sea for a distance of 30 *ri* and a breadth of 3 or 4 *ri*. The sparks from it set fire to and broke down mountain peaks in Kōshū. The scorched earth filled up the lake in the department of Yashiro, in the province of Kōshū, the water seethed like boiling water, and the fish and tortoises all died; the number of dwellings of farmers which were buried, at the same time as the sea, reached some 100 houses.

On the night of the 23rd day of the 11th month of the 4th year of the period Hō-ei [1707 A.D.], there were two shocks of earthquake, and the rumbling and movement lasted long. At the hour of the Snake [10 p.m.], Fuji-san burst into flames, which were very high, and the smoke rose aloft. The cinders fell over some 10 *ri*. Towards the South they reached Okabe, and to the S.W. they reached Kurihashi. On the morrow this partially ceased, but again on the 25th and 26th days it

blazed fiercely; the rocks were riven and flew about, earth and sand fell scorching, and ashes covered the country round Hara and Yoshiwara to the depth of 5 or 6 feet, while at Yedo they were some 5 or 6 inches in depth. The spot from which the flames issued became a wide, yawning cavern, and by its side sprang up a small hill, which goes by the name of Hō-eizan.

Jofuku of Shin came to Japan, and entered the Elysian Mountain.

NOTE.—In the *Honki* he is called Joshi; but in the *Retsuden*, Jofuku.

In the *Shiki* it is written:—

“King Shokō of Shin gave orders to Jofuku to embark on the ocean and seek the Divine Elixir. The latter did not succeed in obtaining it even after many years, his expenses were heavy, and he feared punishment, so he invented the following speech: ‘In the midst of the ocean your servant met with the Great God of the Ocean, and He said’: ‘Art thou a messenger of the western emperor? What is it that thou seekest?’ Your servant replied: ‘I beseech from you the Elixir that lengthens life, and prolongs our years.’ The deity said: ‘The courtesy of your emperor of Shin is but scanty; even though you discover the Elixir, you cannot take it away.’ Your servant accompanied him, and, going towards the S.E., arrived at the Elysian mountain, and saw there a palace in which there was an attendant. He was of the colour of copper, his appearance that of a dragon; light shone out from him and lit up the skies. On this your servant, with two prostrations, enquired: ‘What offering shall I bring and offer to Thee?’ The Ocean Deity said: ‘Bring with thee youths of noble name, or else noble maidens, together with workmen of all arts, and so shalt thou obtain (the Elixir).’ The Emperor of Shin, in great delight, despatched 3,000 persons, noble youths and maidens, and caused them to take seeds of the five kinds of grain, and all kinds of workmen, and sent them away.”

NOTE.—The place referred to was Fuji-san, and the time was the reign of the Emperor Kōrei (290—215 B.C.)

Oyō-ei-shiku says: "At the time of Jofuku's disappearing into the Elysian Mountain, the books had not yet been burned in Shin."

NOTE.—Then Jofuku probably brought with him a large number of books &c.

To sum up, some of the various reports with reference to the place to which Jofuku came to dwell some say that it was Kumano, others, that it was Atsuta, others, again, that it was the "Elysian Mountain" in the neighbourhood of the Fuda mountain. The point is not yet decided, but it is probable that he passed through all these places.

A document which is sold to pilgrims giving the names of the different places on the mountain, commences by saying that Fuji-san is the origin of all other mountains, and its grandeur equals that of the sun or moon.

The following brief notes are extracted from a paper published by Mr. Wada Tsunashiro, in the fourth volume of this Society's Transactions. From chemical and microscopical analyses of the rock, the conclusion arrived at is, that the rock of Fuji-san is an Anorthite basalt.

An analysis of rock from the crater of Fuji made by Mr. Hida, under the direction of Dr. O. Korschelt, gave:—

Silica	49.77
Alumina.....	20.57
Ferric oxide	6.06
Ferrous oxide	5.11
Manganous oxide .....	.20
Lime	10.37
Magnesia	5.00
Potash	0.84
Soda	1.08
Water .....	.73
Phosphoric acid .....	.16
	<hr/>
	99.89
Specific gravity	2.642

Other analyses have been published by Mr. E. Kinch and Dr. Luedecke.

The eruptions of the mountain are enumerated as follows :—

1. 798 (Yūreki 18th year) from the 14th of the 3rd to the 16th of the 4th months.
2. 799 (Yūreki 19th year 3rd month). At this time all the rivers became red.
3. 801 (Yūreki 21st year, 3rd month) April, 802.
4. 863 (Tokuwan 6th year) from 1st of 5th month to 25th of the 5th month.
5. 937 (Shōhei 7th year).
6. 1330 (Genkō 1st year 7th day of 7th month).
7. 1561 (Yikoku 3rd year).
8. 1707 (Hō-ei 4th year 3rd day 11th month). It is probable that this ought to read 23rd day.

The above dates transposed by Bramsen's tables become April 23rd 799, April 800, April 802, June 8, 864, 937, August 12th, 1329, January 1560, and November 15th, 1707. or December 16th, 1707.

From the first eruption a lava stream reached as far as Saruhashi, its length being 8 or 9 *ri* (20 or 22 miles).

At the fourth eruption a lava stream ran down between Kami and Shimo Yoshida.

The eruption was violent and was preceded by earthquakes.

On the night of the 23rd November, 1707, before the last eruption, there were two strong shocks. In Yoshiwara the ashes were six feet thick and in Yedo several inches.

It is probable that the lakes on the northern side of Fuji were formerly united, but were disjoined by lava streams. They are all on the same level (905 meters) and their waters fluctuate simultaneously. This latter phenomenon has given rise to the belief that there is an underground communication between these lakes. To the east and south of Fuji the rocks are volcanic. The mountains to the west are partly syentic, while to the north the mountains are granitic. On the Fuji side these mountains are covered with diabase tufa. It is probable that Fuji has been built up over granite.

In a journal written by Shimizu Sukeemon it is said that

Fuji-san erupted on the 23rd day of the 11th month in the 4th year of Hōei. It lasted until 8th day of the 12th month.

Dr. J. Rein, in his account of Fuji-san (*Der Fujino-yama und seine Besteigung*, Pettermanns Mitt: 1879) tells us that the crater is 4,500 meters in diameter and 167 meters deep. You descend on the south side. A description of the ascent of Fuji-san made by Sir Rutherford Alcock may be found in the *Journal of the Royal Geographical Society*, 1861. Dr. Drasche has also give an account of the mountain (*Osterr: Geologischen Reichsanstalt* 1877).

The height of Hōei-san from which the eruption of 1707 took place is, according to Marshall, 9,400 feet.

It is said by some that in 1707 the ashes which fell in Tokio were 8 in. thick. Traces of these ashes are yet to be seen in Kazusa and Awa.

All the lava streams are now grown over and weather worn.

Dr. E. Naumann, in his paper (*Erdbeben und Vulcanausbrüche in Japan* Mitt: d. Deutschen Gesell: f. Natur und Volkeskunde Ostasiens 15tes Heft) describing the eruption of Fuji-yama in 1707, says that the eruption commenced at a point which was then overgrown with high trees and it continued for 10 days. The first intimation of the eruption was a heavy shock of earthquake at 8 a.m. immediately after which stones commenced to fall. This was on December 16th. It was not until December 31st that all was again quiet. Round the base of Fuji the ashes were 12 feet thick. At a temple 9 ri distant from the top of Fuji they were 3.5 feet thick. In many places the ash was 7 feet thick. In Tokio a fine ash commenced to fall at three o'clock a.m., and in places it was 7 to 8 in. thick. Many earthquakes were felt.

The following note referring to the caves beneath Fuji-san is taken from a book called "Extracts respecting Kōshū Province":—

At the village of Yoshida at the foot of Fujii there is a Shintō temple called Asama Myōjin; 11 *chō* to the west of this there is a large cave—called *Tai nai ana* (Belly Cave). The

entrance is five feet square, and the face of the stone is smooth as if it had been planed down. After entering about forty feet the cave turns aside, and slopes downwards. It must be descended in a sloping (bending) manner; and after having thus gone a short distance, it becomes level again; but the height is so little that one cannot stand up there. One then advances by creeping, and comes to a stone shaped like a woman's bosom, from between which water comes. A hundred feet farther on the cave becomes somewhat wider, and one can walk there. A copper image of Dainichi has been put up in this place. Here there are also stones which hang from the roof, and which resemble the umbilical cord (stalactites and stalagmites). [Here follows a description of various sorts of stones.] Further on there are other caves, but they are so small that no one can enter them. The cave is called Belly Cave because the inside bears a resemblance to the human stomach. There is also a legend that the god Asama Myōjin emerged first from this hole, and it is much frequented by pilgrims to Fuji.

To the south of Fujii there is a rock cave, called *Riogaki*, and it is a tradition that the holy priest Nichiren read the *Hokkekyō* there. There is a Shinto shrine inside it, and a copper post on which is written the sacred formula of the Nichiren sect.

In 1053, the eighth month, fire issued from between the rocks, and even now smoke is frequently to be seen issuing from them.

In 1881 I paid a visit to one of the caves beneath Fuji-san at Stoana. There is a sharp descent to the entrance of the cave which appeared to be about 200 feet long. Our guide said it was 600 feet in length. It is generally about 15 feet in height. Drops of consolidated lava hang from the roof like small stalactites. Near the end you have to wade through water about a foot deep. This brings you to a stone image of a diety called Senyen-san. The cave is here only 3 or 4 feet high. I again ascended Fuji-san in 1884 where, in company with Mr. W. J. Wilson, I remained for five days. In 1881 the as-

cent was made from Suyama, on the South-east side of the mountain viâ Hōei-san. In 1884 we ascended from Subashiri. While on the mountain we had several opportunities of seeing the Kage Fuji or the shadow of Fuji as thrown by the rising or setting sun upon the plain below or the clouds in front. Another remarkable phenomenon was the projection of our own shadows which appeared like misty giants in the clouds. These brocken-like spectres we learnt were sometimes worshiped by the pilgrims. On the outside lip of the crater on the East side of the mountain in several places steam issues from the ground. It was the same in 1881. Some years ago steam issued from the edge of the crater on the West side of the mountain. I examined the ground, and from its sulphury appearance believed the statement. We found the crater to be about 600 feet in depth. At the bottom, with the exception of one or two large rocks, it is flat and sandy. Here and there fragments of sulphur may be gathered. The rocks of Fuji are extremely magnetic. Most of them are black and heavy, but a few, as for instance those forming a dyke which crops up on the North side of the crater, are light in colour. In addition to the large crater there is a smaller crater on the North side of the mountain, lying between the big crater and its outer rim. In addition to the parasitic cone of Hōei-san, there is small hill called Ko-fuji on the South-east side, which was probably formed in 967 (937?)

A traveller's journal of the year 1021 speaks of smoke rising from the top of Fuji on which at night fire was visible. From Japanese poetry and tradition it might be assumed that the smoke issuing from the top of Fuji was a constant feature until at least the 14th century.

Assuming that the fabulous story of the formation of Fuji, which according to different authorities took place B.C., 286, 294, or 301, indicated an eruption, a complete list of Fujis outbursts would be as follows: B.C. 286, 294 or 301, 799, 802, 864, 937, 1021, 1082, 1329, 1560, 1627, 1649, 1700, 1707.

The intervals separating the eruptions have been 491, 65, 73;

85, 61, 247, 231, 67, 22, 51, and 7 years. On my last visit to Fuji-yama I took with me a tromometer or tremor measurer. This instrument also indicates tips of the soil or changes in the vertical. Owing to the difficulties of not being able to undress, to wash, to eat anything but the plainest of food, the rarification of the air, and other inconveniences, myself and my companions were not able to remain on the summit for more than five days. During that time we obtained observations both day and night over a period of three days. These observations were made by observing the position of the end of the pointer of the tromometer as it moved over a scale of millimeters. The instrument was placed on a block of lava deeply buried in ash, inside a stone hut. It was protected by a wooden case with glass doors and a tent of oiled paper. Before commencing observations the weight was suspended for 15 hours by the same wire on which it had been hanging for many weeks in Tōkyō. The results of interest connected with the observations (which are appended) were as follows :—

1. That the movements on the top of the mountain were very much greater than those which I usually observe in Tōkyō.
2. The tremors which are recorded did not necessarily accompany the wind.
3. That during a heavy storm from the S. and S.E. which was sufficient to prevent us leaving the stone hut, the displacement of the pointer was in a direction similar to that which would have been obtained had the mountain been bent towards the N.W. by the wind.

My colleague, Mr. T. Alexander, treating Fuji as a conical solid made of brick with a wind load of 50 lbs. on the square foot found the slope and deflection of a point 100 feet below the apex of the cone. This calculated slope was 2 or 3 times greater than the deflections which I measured. I will not insist upon the fact that a deflection due to the wind actually occurred, but it is certainly curious that the results of calculation and observation should point in the same direction. If the observed deflections of the pendulum had been due to a tip of the mountain, they might equally well have been observed at its base. The observations were as follows :—

DAY	HOURL.	TEMPERATURE FAR:	BAROMETER.	PEN-DULUM.	DIRECTION FROM STARTING.	REMARKS.	
Aug 12	10A	50	19'02	0'5	N.W.	Almost still.	
	11'45	50	19'02	0'5	N.W.	Slow swing from 0 to 1 on N.S. line.	
	12'30	51	18'97	1	N.N.W.	Still.	
	1P	51	—	0		Now and then a slight motion. Temp. in sun 92° F.	
	3	53	18'97	1	S.E.	Slight swing in N.E. and N. quadrant from 0 to 5.	
	4	50	18'95	3	S.E.	Slight movement. Strong wind W. to S.	
	6	48	18'95	4	S.E.	Slight movement.	
	7½	46	18'95	4'2	S.E.	Slight movement. Outside temp. 6° C=42° F.	
	9	46	18'9	3	S.E.	Slight movement. Strong S. wind.	
	10	46	18'95	3	S.E.	Very slight motion. Strong S. gale.	
	13	0'45A	46	18'95	2	S.E.	Slight motion. Strong S. gale.
	4'30	42	18'92	1'5	S.S.E.	Slight motion. Swings from 1 to 2'5, S.E. to S. Strong gale.	
8	45	18'92	2'5	S.E.	Swings 2 to 3 N. and S. South wind. Gale abating.		
9'30	45	18'92	1'5	.....	Swing 1 to 2 in the E. and N.E. quadrant. Mist and rain. S. wind.	
10'30	45	18'9	1'5	.....	Swing 1 to 2 in the E. and N.E. quadrant.	
12	45	18'9	1'5	.....	Slight swing in E. and N.E. quadrant. Still strong S. wind and rain.	
1½P	46	18'87	1	.....	Slight swing in E. and N.E. quadrant. Strong S.E. wind and rain.	
2'45	47	18'87	1'5	.....	Slight swing now and then 5. Strong S.E. wind and rain.	
4'45	48	18'87	2	.....	Swings 1'5. to 2'5. Barometer pulsating or in. wind abating, rain continues.	
7	50	18'91	1'5	.....	Slight swing 1 to 2 E. and W. No wind. Mist.	
9	46	18'95	2'25	.....	Swing 2 to 2'5 on E. line. Slight W. wind. No rain.	
14	0'15A	46	18'95	2'5	Swing 2 to 3 on E. and S.E. quadrant. Fine night. Moon up.	
3	44	18'96	2	.....	Swing on division 2 N.E. and S.W. In S.E. quadrant.	
6	43	18'96	2'5	.....	Swing on S.E. line '5.	
7'30	45	19	3'5	.....	Swing on E. and S.E. quadrant between 3 and 4 S.E. and N.W.	
11'30	46	18'99	4'5	.....	Swing on E. and S.E. quadrant now and then swings to 5. Position of pointer E.S.E.	
1 P	48	18'97	5'5	.....	Swing motion in E.S.E. quadrant.	
2'10	46	19	6	.....	Slight E.W. motion in E.S.E. quadrant.	
3	48	18'99	6	.....	Slight E.W. motion in E.S.E. quadrant.	
4	47	19'01	6'25	.....	Slight E.W. motion in E.S.E. quadrant. Slight W. wind.	
5	47	18'98	6'25	.....	Slight E.W. motion in E.S.E. quadrant. Slight W. wind.	
6	46	18'98	6'25	.....	Slight N.E. S.W. motion in E.S.E. quadrant.	
7	46	18'95	6	.....	Slight N.E. S.W. motion in E.S.E. quadrant. Wind dropping.	
8	46	19	5	.....	Slight motion E.S.E. quadrant. W. wind rising.	
9½	45	19	5	.....	Slight motion E.S.E. quadrant. Wind dropping.	
11½	44	18'95	5	.....	Swing 4'5 to 5'5 in E.S.E. quadrant. W. wind strong.	
15	1 A	42	18'9	5'25	Swing 5 to 5'5. Strong W. wind and fog.	
3'45	42	18'93	4'5	.....	Swing 4 to 5. Strong W. wind and fog.	
7	44	18'1	4	.....	Nearly still. Strong S.W. wind and fog.	
8	44	18'94	4	.....	Slight movement. Wind dropped. Heavy fog.	
9	44	18'94	4	.....	In E.S.E. quadrant still. S. wind gentle.	

After this last observation a quantity of water was poured round the foundation and next hour several observations were made but no change in reading could be detected. All the thermometer readings are about 1.5° too high and the Barometer readings .068 too high. Although none of the temperature readings indicate freezing, water in the doorway of the hut was several times thinly covered with ice. Under the boards on which we slept there was a thick bed of ice and in the adjoining crater about 600 feet deep there were large beds of snow.

The most remarkable feature connected with the Fuji-yama is its shape, which has earned it the title of the peerless. It was seeing Fuji-yama which led to me in 1875 to investigate the form of volcanic cones (see *Geolog. Mag.*, No. 8, August, 1879, and No. 11, p. 506, November, 1879). On the profiles of a number of volcanoes traced from photographs, I drew a series of ordinates at equal distances apart. The sum of equally spaced pairs of cordinates divided by their differences I found was nearly constant, which is a peculiarity of a logarithmic curve. This is the curve which would be assumed by a self-supporting mass of coherent materials. This subject is more fully discussed under a section in this paper entitled the form of volcanoes. (*See Plates 2 and 3.*)

HEIGHT OF FUJI-YAMA.

During the five days that I spent on Fuji-san in the year 1884, barometric and thermometric readings were made almost hourly. From these records, coupled with barometric readings made at Hamamatsu, Numadzu, and Tōkyō, Captain T. W. Blakiston computed the height of Kegamine, which is a peak about 233 feet higher than the tenth station which is on the rim of the crater. Mr. Knipping, who made calculations of the height of Fuji-san, only allowed 200 feet above the tenth station. Stewart determined the height by levelling with an omnimeter. Chaplin computed a height from trigonometrical observations, and after a critical examination of all preëxisting

observations gave the height as 12,441 feet. All the methods employed are subject to error, and different heights may be obtained by different methods of calculation especially when barometrical data are employed.

Among the numerous results which may be obtained from the barometrical observations made when I was on the mountain, I quote the following :—

SUMMARY OF CALCULATIONS.

	10TH STATION.
Trautwine with sea level at 30 inches	12,481
Trautwine with sea level at 29.6 inches	12,288
Royal Geographical Society with sea level at 31 inches.....	12,508
Royal Geographical Society with sea level at 29.6 inches	11,808
Molesworth with sea level at 29.6 inches.....	11,820
Royal Geographical Society with sea level at 30 inches.....	12,470
German method (Neumayer's)	12,494
Mean	12,410
Add	235
	12,645 feet.
By regular methods (unmodified)	
Trautwine	12,481
Royal Geographical Society	12,508
German (Neumayer)	12,494
Mean	12,494
Add	235
	12,729 feet.

Another value obtained by Blakiston was 12,563.

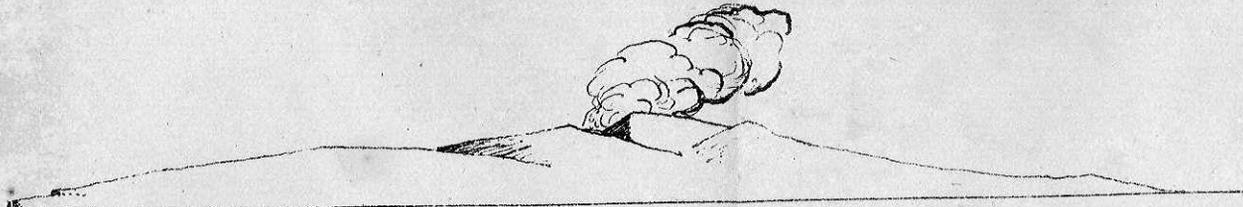
The following tables give the heights obtained by different observers, together with mean values for the height when differential values are given to the different observers. A high value is given to Knipping, whose barometrical observation on the summit and at the foot of the mountain extended over many days; to Stewart who levelled the mountain, and to Chaplin who computed the height trigonometrically and carefully examined all pre-existing observations :—

HEIGHTS OF FUJI.

Siebold.....	12,441	Humbolt's "Kosmos," Vol. V. p. 374 (Bohn, London, 1876.)
Alcock	14,175	Professor W. S. Chaplin, "Memoirs of the Science Department, Tokio Uni- versity, 1881."
Fagan	13,077	
Williams	10,712	
Lépisier	11,539	
Knipping.....	12,395	
Stewart	12,364	
Fenton.....	12,372	
Favre-Brandt.....	12,359	
Mendenhall.....	12,527	
(Nakamura and Wada) ..		
Chaplin (Futami)	12,439	Rein's "Japan," p. 61 (Eng- lish Edition).
Rein	12,287	
Schutt	12,349	Trans. Ger. As. Soc. of Japan, 1882.
Milne	12,729	Barometric measurement, August, 1884.
Mean	12,412	

A. Alcock	14,175	G. Fenton	12,372
B. Fagan	13,077	H. Favre-Brandt	12,359
C. Williams	10,712	I. Nakamura & Wada..	12,527
D. Lépisier	11,539	J. Siebold	12,442
E. Knipping	12,430	K. Chaplin (Futami) ...	12,439
F. Stewart.....	12,364	L. Milne	12,563
Mean of all giving equal value to each observer	12,417	Mean of all giving dif- ferential values	12,437
Mean of all giving dif- ferential values		A. B. C. D. G. H. J. 1 Remainder as in last case	
A. B. C. D.	12,432	Mean rejecting A. B. C. D.	12,439
G. H. J.		Remainder valued as in last case	
E.		Mean rejecting A. B. C. D. G. H. J.	12,444
F.		Remainder valued as in last case	
I.			
K.			
L.			

One conclusion we arrive at is that the height of Fuji-san lies between 12,400 and 12,450 feet. The height to within ten or twenty feet like that of nearly all high mountains in the world is unknown. It has been suggested that volcanic mountains may decrease in height owing to a subsidence of their eviscerated foundations. A phenomenon of this kind may be taking place at Fuji-san.



Oshima. 2556 ft.



Tosima 1736 ft.



Utoni 666 ft.



Niishima 1496 ft.



Kosuohima 2000 ft.

Some of the Oshima Group as seen
from near Shimoda.



Ideal section of Oshima (Naumann)

a. first crater at Hafeu

b. second crater

c. third crater Shihara.

Plate 4.

The total number of eruptions recorded are therefore twenty, but if those which are bracketed together are taken as being identical, the number of eruptions are reduced to twelve.

OMUROZAN (IDZU).

Mr. Earnest Satow, who ascended this mountain in 1880, tells me that on the top there are blocks of lava and slopes of scoria. The crater, which is worn and covered with grass and scattered blocks of lava, is about 250 yards in diameter and about 80 feet in depth. Its general shape is that of the frustum of a cone.

Komurosan is another volcanic peak.

OSHIMA. (*Plate 4.*)

THE VOLCANO IN THE ISLAND OF OSHIMA, AS RELATED BY A
KŌCHO CALLED NAGASAKI KŌHEI, ON THE 13TH MAY,
11TH YEAR OF MEIJI (1878).

This volcano is situated in the centre of the island of Ōshima, and is called Miharazan. Its height is about eight *cho*, and its circumference about six *ri*. Around the foot of the mountain there are six villages. The distance from the nearest villages to the top of the mountain is about 1 *ri*; from other villages it is about 3 *ri*.

When the mountain is covered with thick mist or at the time when a south-west wind is blowing, ascent is impossible. From the top smoke is constantly issuing. The time when it first issued is not known, but during late years the eruptions in the years of Temmei (1781), and Kansei (1789), were probably the most severe. At the latter date a village called Shimotaka was entirely destroyed. Everything, including both people and animals, were buried by ashes. When at the present day the ground of this district is explored, bones of men and fragments of earthenware are sometimes taken out, and as the ground cannot be cultivated it remains barren land.

A great many years after this, an eruption occurred on the

4th January, 10th year of Meiji (1877). It was very severe, and a vast quantity of ashes, &c., fell in many places; during the night a red flame appeared, and at noon the sky was blackened by smoke. This continued for several days until at last it became more settled. During this eruption it was not necessary for the people to leave. At the present day only smoke issues, and it is used by the sailors to tell the direction of the wind. When the quantity of smoke which was issuing had decreased the smell of sulphur became less. At the present time both the smoke and the smell are very slight. At a place about 15 *chō* south-west from the volcano, smoke is always issuing from the sands. On this account no trees nor vegetation will grow there. When there is wind and before the falling of rain, the smoke is greater than usual. The top of the mountain is about 10 *chō* in length and 5 *chō* in breadth, and is generally level. A little below this there is a flat place of about 5 *chō* in length and 3 in breadth. This is not so level. The form of the mountain is like that of a comb. There is one crater on the top of the mountain, and the length of it is 5 *chō* and the breadth about 3 *chō*. The form of the crater is like that of the harbour of Namiuki-ko which is in this island near the crater. For a distance of about 1 *chō* the heat is so fierce that no one can approach. In consequence of this the depth is unknown. The smell, which is so strong also, makes, it difficult to approach.

In January, 10th year of Meiji (1877) a European came to visit the volcano. He entered the crater, but could not properly examine it. From the half way point up to the top the mountain is chiefly covered with lava of a reddish black colour. This is very light like ashes, and no tree can grow. Lower down small plants of a red colour are found. On this mountain springs are rare but at one place; about two-thirds up the mountain, there is a hot spring. The islanders call the volcano Miha-miyojin and regard it as a kami or god. At the foot of the mountain there is a stone portal like those which are generally seen at the entrance to a Shintō temple. The island of

Oshima is 5 *ri* in length and 3 *ri* in breadth, and the circumference is 11 *ri*. The dwelling-houses are numbered at over 990, and the population at above 5,000. As there are no rice fields in the island, the islanders cultivate barley, millet, taro, &c. They live chiefly on the barley. There is so little water in the ground that it is necessary to carry water from the spring in the mountain. At the present time there is a small pond in which rain water collects. This pond was made artificially. Of the six villages on the island, the inhabitants of three of them carry on fishing and those of the other three sell firewood. The firewood is sold to the people of Honshū or Nippon in return for grain, salt, &c. The best kind of wood on this island is that of the cherry-tree. There is only one kind of bamboo, and this is only found at one of the villages. In this island, with the exception of dogs, cats, and rats, there are no other animals. In former time there were *suigyū* or buffalo. These were driven out because they spoiled the vegetation. Earthquakes in this island do not appear to be so severe as they are in Tōkyō. For instance, at the time of the great earthquake in the year of Ansei, no houses were destroyed in this island, whilst in Yedo a great number were destroyed.

Mr. Chamberlain, in his "Vries Island: past and present," Transactions: Asiatic Society, Vol. IX., p. 173, gives the following list of eruptions:—

A.D. 684, 10th moon (according to the Nihongi or "Chronicles of Japan" it was in 685).

1421, 5th May.—An eruption at Oshima with a noise like thunder. The sea boiled and the fish died in shoals.

1684, 31st March.—This eruption lasted seven years.

1703, 30th December.—Great earthquake and tidal wave; the land about Habu broke down, and became part of the sea.

1777, August.—Four or five inches deep of ashes. The mountain was almost perpetually in eruption until the autumn of 1792.

1837—1857.

1868, Lasted four days.

1876, 27th December lasted till 1877, 6th February.

In company with Dr. Naumann, I visited the mountain during this last eruption.

In 872 there was a volcanic disturbance at Oshima and in its neighbourhood, a new island was created. Other eruptions noted by Dr. Naumann are April 1433, January 16, 1696, November 22, 1716 (an earthquake) with a sea wave which reached the Hafu crater and converted it into a harbour. 1779, and the Autumn of 1794.

A chemical examination of the Oshima lava made by Dr. O. Korschelt gave the following result :—

SiO ₂	52.42
Al ₂ O ₃	14.30
FeO	13.70
MgO	5.38
CaO	9.35
K ₂ O	6.28
Na ₂ O	2.02
H ₂ O .....	.14

On the assumption that the potash goes with the Sanadine and a comparison of the soluble and insoluble portions of the rock, the percentage mineral composition may be written :—

Sanadine	36.33
Labradorite	21.09
Augite	28.99
Magnetite	12.64
Water .....	.14

The rock is basic. From the above and a microscopical examination, the conclusion arrived at was that the stone was an Augite Andesite (Naumann).

The following is a description of the visits made to Oshima in 1877. It is extracted from the *Geological Magazine* (Decade II., Vol. I. No. 5, May, 1887).

After some trouble, a party was organized and a steamer engaged to visit the scene of the eruption. We left Yokohama on the afternoon of the 18th January, 1877, and in the evening reached Kanasaki, a village situated at the extremity of the peninsula upon the south side of Yedo Bay. After staying

here a few hours, we continued our course, and reached the island shortly after daybreak on the following morning. During the night there was an uninterrupted view of the volcano, from the summit of which huge clouds of steam, lighted up with the glow from the crater beneath, could be distinctly seen. It was a veritable "pillar of fire."

The island, which is about eight miles long, and very mountainous, has only one harbour, and this is useless but for vessels of small size. It is called Habu, and is situated near the S.E. corner of the island. It is entered by a narrow gap in cliffs of stratified and contorted agglomerate. This entrance is shallow, but the harbour itself is about fifteen mètres or more in depth, and is surrounded by apparently almost perpendicular cliffs of stratified trachytic and brecciated rocks. It is in fact the crater of an old volcano, and is stated by the people of the island to have been first occupied by the sea about 100 years ago.

From the people on shore we learnt that the eruption had commenced on the 4th of the month (January 4th 1877) and therefore it had been sixteen days in action. The only notice that they had of its outburst was a loud explosion, which was described as having produced a slight vibration. This appears to have been all that was felt of the nature of an earthquake, and so far as the inhabitants of the island were concerned, all was going on quietly. They told us that cinders were being thrown out of the crater, and that seven years previously, there had been a similar eruption, which, however, only lasted two days. Twenty years before that they said it was always in eruption. Information, however, was difficult to obtain, and uncertain in its character. None of the inhabitants, although not more than four miles distant, had visited the crater, and, as we shortly afterwards found out, did not appear even to know the way to it.

Securing the assistance of six men, we set out by a zigzag road towards the top of the old crater, in which the village is situated and where our vessel was lying at anchor. The sides of this crater

had, near the place where we ascended, an inclination of from 40° to 50° . We were soon amongst a network of small lanes and footpaths overshadowed with bamboo, alder, and other trees. Once or twice our path led up to a small water-course, the black ashes forming its bed becoming coarser and coarser as we ascended. Next we were ascending the course of an old lava-stream over black andesitic boulders. Then again we were in steep gullies and narrow lanes, the side of which were made up of stratified beds of ashes, all dipping at various angles down towards the sea. Once or twice we reached a small open space, and obtained a view of the bare peaks towards which we were travelling. Whilst resting on one of these, we could distinctly hear a series of explosions, which sounded like the sudden escape of large quantities of steam, and we saw clouds of vapour rising from behind the nearest summit. After struggling along for nearly two hours, we found that the men we had engaged as guides did not know the road, and were leading us round the island rather than up towards the crater. Meeting with a lava-stream of tolerably large dimensions, which was filling the bed of a gully, I struck up along its course, expecting that it would lead to some crater or other on higher ground. At several points along its course we met with obstacles where the lava when molten had made a precipitous descent, like frozen waterfalls, which involved some tedious climbing and scrambling through the bushes which thickly covered the almost perpendicular walls of the ravine on either side. The rock of this stream was andesitic of a very dark colour, and extremely vesicular. The general direction of the vesicles in the lava was that of the stream; but there were so many exceptions to this, owing to irregularities and obstacles in its course, that they could not be taken, unless seen as a whole, as indicating the original direction of the fluid matter. When lava flows over an even course, such deductions might possibly be made, even if the stream were only examined at one point along its course. In some places along the stream my companions observed the charred trunks

of several trees which had probably been overwhelmed during its flow. That these trees still remained seemed to indicate that this stream must have been of recent origin. After about an hour's climbing, we were above the line of vegetation, and instead of trees and bushes being on either side of us, we now had hills of ashes. On one of them my friend Dr. Naumann met with beds of tufa, in which were impressions of plants, which, from some attached rootlets, appeared to have been buried where they grew. From the position of these beds and their contents it was evident that vegetation once extended much higher up the sides of the mountain than it does at present, and that it was probably destroyed by a volcanic outburst.

We now directed our course towards the highest peak before us, at the back of which we hoped to see something of the eruption. After a tough scramble through black, scoriaceous ashes, we reached the top, where we soon saw that we had much further to travel. We had in fact reached the rim of an old crater the sides of which descended perpendicularly I should think for at least 400 feet. Walking along this rim, which was covered with large weather-worn whitish boulders, which looked not unlike material which had been torn from the perpendicular faces below us, we found a slope of ashes, down which we descended into the bed of the old crater. On looking at the face of the perpendicular cliffs from the top of which we had just descended, we saw they consisted of irregularly broken and contorted bands of a whitish rock like trachyte, more or less parallel. They were capped with beds of ashes. In these ashes, as in the most scoriaceous portions of the lava, crystals of a glassy felspar were very abundant. In the more compact lava they were absent, that is, to the naked eye. The rim of this old crater, although a serious obstacle on the side of our ascent, is not continuous round the mountain, and is only to be seen on the south and south-western side.

After collecting a few specimens of rock from a black-look-

ing mass which was probably the throat of an old vent, we proceeded forwards to make the ascent of another cone of ashes which, from its position, was evidently that which remained of the eruption succeeding the one which formed the crater we were then leaving. The explosions we had heard when at a greater distance were now more audible, and occurred rapidly in succession. As we neared the top which was about 800 feet above the plain from which we started, the noise, which was like that of immense jets of steam, was sometimes accompanied with a tremulous motion of the ground. It was not long before we reached the rim of the second crater, which we did to behold a sight of extraordinary grandeur. Instead of looking up at a crater, we were looking down at one. Standing on the rim of the crater before us there was a short descent of loose, black ashes, somewhat steeper than that up which we had climbed, terminating suddenly in perpendicular cliffs, which formed an amphitheatre of rocks about half a mile in breadth, the walls of which, upon the opposite side, were about 300 feet in height. At the bottom of this pit, on the side nearer to us, a small cone, with an orifice of about 50 feet in diameter, was belching masses of molten lava to a height more than double that at which we were standing.

The explosions, which varied in intensity, occurred about every 2 seconds, but sometimes there was a pause for 15 or 20 seconds. At the time a strong wind was blowing at our backs, which kept any of the lighter lapilli from driving in our direction. Coming, as we did, so suddenly upon the precipice-like edge of a huge black cauldron, roaring, shaking the ground, and ejecting a dense column a red-hot stones and ashes, the wild and dismal aspect of which was heightened by dark clouds, driving rain, and a heavy mist produced at first a feeling of timidity, which was so strongly shown by our six so-called guides that it was with difficulty they were prevented from taking to precipitate flight.

The cone at the bottom of the cauldron before us, together



with a large quantity of lapilli and bombs scattered over the ground on which we stood, were the result of 16 days' activity. Three years ago, in the place where this new cone now stands, there was a deep hole, from which steam was issuing.

The great interest in this eruption lay in the fact that we were able, on account of our position, to look down into the crater. In the intervals between the ejections the interior could be well seen, and it was observable that the sides had a slope of very nearly the same inclination as the exterior. Now and then large masses of these interior sides, which were black, would slide down towards the throat of the crater, and reveal a red-hot interior, showing that cone itself was probably internally red hot throughout. One side of the cone had been blown away, leaving a breach, almost level with the plane from which it rose. The opening greatly facilitated our observations. Looking down into the crater on this side, molten lava, approximately level with the base of the cone, could be seen. At each explosion it rose in waves, and swayed about heavily like a huge basin of mercury, a little of it being apparently pushed forwards through the breach to add to a small black-looking stream upon the outside. The explosions, which I have referred to several times as resembling outbursts of steam, might be compared to the escape of steam from a slowly-working non-condensing steam engine greatly magnified.

On listening attentively, a rattling could sometimes be heard, reminding one of stones and pebbles on a beach driven forwards and drawn backwards by the advancing and retreating surge. This I think could hardly be due to the churning of stones in the mouth of the crater, which was not only short, but it expanded upwards, forming a funnel-shaped opening. Nor was it in the throat of the crater; for, so far as I could see, that was filled with molten matter. It is, however, difficult to imagine it to be due to the contact of particles brought about outside the crater, which is the only place remaining to which the origin of the sound can be attributed.

Each explosion, as I have said, produced a mountain like column of red-hot ashes and volcanic bombs. The height to which they sometimes rose must have been nearly 1,000 feet. Many of them appeared to be of a feathery lightness. As they rose, their velocity became gradually less and less, until they seemed to pause and float in mid-air, before turning to descend, which they did with an augmenting speed. The large masses only rose to a comparatively small height. Many of the pieces fell upon the sides of the exterior of the cone from which they had been shot, where they at once created a small cloud of steam, and rolled a short distance down its side to form a natural slope. As the material, which approximately fell vertically, increased in quantity, the angle of this slope would naturally increase up to a certain point, because, where the slope is short, any material that might fall upon its side has sufficient momentum to roll to the base; but as the length of slope increases, an element of friction is brought to play, which prevents such action taking place. The direction in which the material was shot up was generally vertical, but sometimes it had a little inclination in a direction opposite to that in which we were standing. Should the ejections from a volcano not be in an approximately vertical line, or during the time of its action winds should blow in one direction more than another, we might reasonably expect the resulting cone, which would be formed by the falling material, to have a less steep inclination upon the side where the greatest quantity of material had accumulated. Such actions may perhaps give some explanation to the slight differences in slope which are so often to be observed in recent conically-shaped volcano mountains. This is of course presuming that the form of the mountain has not been materially altered by subsequent denudation. Many of the larger pieces often appeared to separate when in mid-air. This I do not think was due to any explosion which took place within them, but rather perhaps to some such cause as a sudden cooling.

Looking at some of these bombs, which had fallen on the

level where I was standing, they appeared to have have done so whilst in a pasty condition, because some of them showed a decided flattening, as if produced by impact. Both the bombs and lapilli were of a black colour, and pumicious texture. Although I believe each of those explosions to have been the result of a sudden bursting of steam through the molten lava, I did not see any aqueous vapour which I could recognize as having been evolved whilst I was standing near the crater. This may have been perhaps due to the intense heat keeping the vapour in an invisible state until it became hidden in the fog and murky atmosphere which enveloped us.

Notwithstanding a strong ice-cold breeze blowing in the direction of the eruption, which was about 150 yards distant from us, the effect of radiation was distinctly felt, especially when the ejected column of ashes was large.

Independently of variations, produced by unusually large ejections, two thermometers in boxes were each raised 3° C. so long as we remained in this position. This warmth was all that made our position bearable, as otherwise it was bitterly cold, with a sleety rain pouring down, and we were all wet through. Once or twice a little fine ash fell upon us, and a slightly sulphurous smell could be detected. The journey down the mountain was accomplished in about two hours, which was half the time it had taken us to ascend.

From the inhabitants we learnt that the mountain is regarded as being holy, and that at certain seasons they make solitary pilgrimages to its summit. We, however, had been the first to see the eruption.

Earthquakes, although so common on the mainland, are said not to occur here; and the only shocks that have been felt are those which were produced at the time of the breaking out of the volcano. This statement appeared to find some confirmation in the fact of a strong earthquake having occurred in Yokohama and Yedo at the time of our making our inquiries, without being perceived by us. Several other localities in

Japan are reported as being free from such annoyances ; but how far these statements may be relied on needs investigation. Some of these districts are in the neighbourhood of recently active volcanos. If it is admitted that in the immediate vicinity of certain active volcanos, earthquakes are unknown, whilst in the surrounding districts they are strongly felt, the idea would at once suggest itself that round these particular volcanos, conditions exist which ward off the advance of any seismic wave. Thus, for example, a lake of lava beneath the unaffected area might accept a wave, but, for want of proper contact with the rocks above, would be unable to transmit its effect in their direction. Owing to the state of the weather, and the short time we remained upon the island, conditions were very unfavourable for making accurate observations.

Next morning we set sail for home, a distance which in coming had been traversed in six hours ; but in returning, through the roughness of both wind and water, occupied two days.

MIYAKE-JIMA.

In the 20th year of Kan-ei, 2nd month, 12th day, March 31st, 1642, about 6 o'clock in the afternoon, a loud report like thunder was heard. This was accompanied by heavy rain. At about 8 o'clock an eruption took place and the village of Akō was entirely destroyed by fire. Furthermore, to the west of the island, the land rose up and threw out large quantities of both sand and stones. This continued about three days.

Shōtoku, 1st year, 12th month, 28th day (February 4, 1711), about 6 o'clock in the afternoon a violent earthquake took place accompanied by loud roaring. About 7 o'clock fire appeared at the foot of the mountain. This soon disappeared, but at Kuwakheria fire broke out and stones were thrown in all directions.

Near Tasunega-hama, fire burst out in the sea at the distance of two *chō* from the shore. It was also seen three or four *chō* towards the north-west. The inhabitants of the

villages of Akō and Tsubota ran away, being afraid at their proximity to the burning places. When they came back, which was after seven days, they found that all the houses in the village of Akō were buried in water and ashes which had been thrown out by the eruption. Their farms and cattle were destroyed and a number of places were still giving off smoke.

Bunka 8th year, 1st month, 3rd day (January 27th, 1811), 12 o'clock at night, tremendous explosions began in the neighbourhood of Ōyama and the people were greatly astonished thereat. Opening their shutters they saw fire burning on the top of the mountain. The shaking of the earth continued till the next morning. On the 5th day a messenger came from Izu-mura telling them that two parallel grooves having a width of about one *shaku* were formed on the top of the mountain Nitān-hara, reaching down to Daibon-no-hama on the shore. Between these grooves there was a distance of about six *shaku*. Another two grooves were also formed on the Take-shinden. These opened from the top of the mountain and extended toward Anegakata. The earthquakes did not cease until the 8th day, and the roaring sounds continued in the valleys after that day. One remarkable event was that at Sone, in Kannago, there had been a wonderfully large stone under which farmers took shelter when they encountered sudden rain. This, they found, had disappeared. On looking about they at last found it lying in a small valley some twenty feet lower down. As there was no possibility of the stone having tumbled down, it seems, it must have flown up into the air and then dropped into its new position. Scoria and ashes accumulated everywhere. A big stone of about 6 feet in diameter, 4 feet in length, 3 feet in width, in front of a shrine in the mountain was cracked and lost. All the neighbourhood was covered with scoria about 1 foot 5 or 6 *sun* deep. Where it was thinnest it was at least 1 foot thick.

Tempō, 6th year, 9th month, 21st day (November 11th, 1834), from early in the morning it rained heavily. At midday

earthquake shocks were felt several times. They were accompanied by roaring sounds. Many people were frightened. A strong wind blew from the east. Thick and dark clouds covered the sky above the village of Idanimura and in the direction of the village of Akō-mura. The roaring gradually increased. When the mountain was looked at, it was seen that smoke was issuing from it and an eruption seemed to have taken place near the cultivated ground of Nagane which lies between Idani and Akō-mura. At the place where the eruption occurred a large quantity of lava, &c., accumulated. In a village called Tsubota-mura no one knew about the event, and only a small earthquake was felt. At the village of Idanimura, the roaring and general effects of the eruption were especially severe. A large quantity of lava, ashes, &c., fell upon the village. At about 2 p.m. the burning became less but the roaring and smoking still continued. On the 23rd a severe shock was felt at several places and much damage was occasioned. At a place called Yukawa, Akō-mura, a hot spring was created. The shaking continued up to the 29th, after which it became very quiet. A crater was formed in Kasajiyama, the depth of which was unknown. The lava and ashes which had accumulated at a place between Nagane and Naka-yama, Kan-non, seemed to have come from this opening. On the 29th January of the next year several officers were appointed to examine the damaged places. They observed that near the top of Hiraboyame there were thirteen small craters. In Kawada, Akō, Idani, and in some other villages there were fissures of from one to two feet in width. At the village of Idani the water in a river was dried up. At a place called Takane-yama a hot spring was created. On the night of the 15th Feb. a severe earthquake occurred about 8 o'clock. On the 16th and 17th of that month shocks were also felt.

July 3rd, 7th year of Meiji (1874). At 12 o'clock during the day the island of Mitake-jima began to tremble. This was accompanied by roaring sounds. At the same time the middle part of the north-western side of Mount Yu-zan, or Ōyama, began

to throw up huge rocks and burned stones. Some were five feet in diameter. The sky was covered by smoke so thickly that the light of the sun could not be seen. Many people feared and fled to Hon-mura. Feeling that even at Hon-mura it was still dangerous, they escaped to Idsu-mura. Those who were labouring in the fields ran here and there. Ashes and stones fell in many places. In Tōgō 30 houses were burned by the falling of the hot stones. At this time in Akō-mura all that was felt was a small earthquake. On the 4th the mountain burned continually, and the burning area increased towards Tsubota-mura. On the 5th it was a little quiet, but the flame and the smoke were the same as before. Every hour or so there was a great roaring like that of cannon. On the 6th a fishing boat arrived from Nii-jima and told the people that on the night of the 2nd smoke and flame appeared on Nii-jima, and on the following night it still continued. In the former island nobody knew about the event of the 3rd. Up to the 6th the wind was from the south. On the 7th it was from the north, and at 10 o'clock in the morning it rained and all the people were very pleased thereby. On the 8th there was a north wind and every thing became calm and the smoking became also less. On the 9th the wind blew from the west and on the 10th it rained. On the 15th there was a south wind and it was a very fine day. The Kochō and several other officers took advantage of this and went to the place where the ground was covered with ashes. They found that it had a length and breadth of about 40 *chō*. Along the sea shore, a sandy tract about 5 *chō* in length and 14 *chō* in breadth was found to be newly annexed to the main land. In the places where the ashes, &c., had fallen, all vegetation had been destroyed. At one small place, however, everything was uninjured. In the neighbourhood of Tsubota-mura several places were burned by the lava. At this place there was a man called Denemon who was a charcoal burner. At the time of the eruption he was burning charcoal near the crater. After the event he was searched for, but as he could not be found it was imagined

that he had been killed. Except this man no one was injured. On the 6th August several Kochō were appointed to inspect the spot from the sea. They came in a boat. They reported that the sea shore had a strong smell of coal and sulphur. About 6 *chō* from the sea shore the water was hot and on the very edge of the bank the water was so hot that one could not put his hand into it. The smell was so strong that one's face became black and seemed as if it had been charred; 35 days after that day it was still hot.

Dr. Naumann mentions an eruption on July 3rd, 1876, on Miake.

In the 3rd year of the reign of Jōmei Tennō (1294) an island was created in the sea of Idzu, and on the 15th day of the 12th month in the 10th year of Keichō (23rd January, 1606), an island was created in the open sea near Hajijō-shima.

HACHIJŌSHIMA.

The Island of Hachijō consists of two volcanoes. These are 2,840 feet in height above sea level. The mountain in the central part is called Mihara-zan. At the foot of this there are five villages. At the western extremity of the island there is a mountain called Hachijō-Fuji. This is so called on account of its likeness to the famous Fuji. Owing to its situation the natives call it Nishiyama (western mountain). The village Mine-mura in Taiga-gōri is situated between these two mountains (Miharayama and Hachijō-Fuji or Nishiyama). There the surface of the ground is rather flat. This locality is called Sakanoshita. The village Kashitate-mura, on account of its lying on a steep part of the mountain, is called Sakanone. In the centre of Mihara-yama, a mountain runs from south to north and divides the island into two parts. The road is narrow and uneven. Goods are carried by horses and oxen.

Nishi-yama, also called Hachijō-Fuji, lies in the north-west. The circumference of it is about 9,700 *ken* and the height of it, about 1,530 *ken*. It extends down into the sea. At the

top of it there is a large crater whose diameter is 276 *ken* and circumference 810 *ken*. In former times smoke was issuing from it. At the eastern end of this mountain there is a small hill. At the back of this there are two small ponds and one large crater. The depth of the crater is about 1,000 feet. No plants grow near it, but in a S. E. direction there grow some very fine tobacco plants. From the middle part down to the bottom, many trees, &c., are to be seen. Mount Mihara-yama lies in the centre of the island. At the top of it there is a concave hollow. At the foot there are five villages. The mountains in the island are all thickly covered with large trees. There is a lake in the island. The height of the mountain is about 2,800 feet and it occupies about a seventh part of the whole island. It belongs to the five villages. The peaks of the mountain are called Shōka-mine, Akabane, Dōga-mine, Hokokuzan, Ōzawa-san, Kamo-yama, and Kegushi-yama. Trees of almost every sort grow upon this mountain. There are no roads on the mountain and the greater part of it is covered with lava.

ADDITIONAL NOTE.

The following is a brief account of the island of Hachijō written by an officer who was appointed from Tōkyō-fu to make an official examination of it. There is a crater at the top of Hachijō-Fuji. It is said that during the year of Kan-sei (1789-1801) smoke was issuing from it. Before the eruption of a volcano in the island of Mitake-jima which was in the 7th year of Meiji (1874) the smoke from the volcano of Ōshima stopped and the natives were very much afraid. A few days after an eruption took place in Mitake-jima. At this time an earthquake was felt in the islands of Ri-jima and Nii-jima, which are between Oshima and Mitake-jima. By this the north-eastern shores of these two islands were destroyed.

In 1880 the U.S. gunboat *Alert* discovered a volcano about three miles N.W. of San Alessandro, which was then throwing up large masses of black mud and ashes.

In 1881 on the spot where this volcano existed there was no bottom at 22 fathoms. (See *Japan Gazette*, July 28, 1881.)

VRIES ISLAND GROUP.

	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Un- known.	
632														Island formed.
684-5														Eruption of Ōshima (Vries Island).
1421					5									Do. Do.
1696														Island formed near Hachijo.
1642			31											Miyakejima. Eruption. [seven years.
1684			31											Ōshima (Vries Island) Eruption lasted
1793												30		Do. Volcanic disturbance.
1711		4												Eruption at Miyakejima.
1777														Ōshima (Vries Island) Eruption.
bet. 1789														Hachijo, Eruption.
„ 1801														Do. Do.
1811	27													Miyakejima, Eruption.
1834											11			Do. Do.
bet. 1837														Ōshima (Vries) Eruption.
„ 1857														Do. Do.
1869														Do. Do.
1870														Do. Do.
1874						3								Miyakejima Do.
1876										27				Ōshima Do.
1876						3								Miyakejima Do.
	1	1	2	-	1	-	2	1	-	-	1	2	7	

ASAMAYAMA.

ACCOUNT OF THE PHENOMENA IN SHINSHŪ AND JOSHŪ IN THE PERIOD TEMMEI (1781-1782).

Mount Asamagatake in the district of Saku-gōri in Shinano, is next to Fuji-yama in height.

In the ridge of the mountain there is a fire always burning. It is not known when it first began to burn. In the *Keizan-Rojin Himondō* it is said that the mountain contains sulphur and there are three ponds of turbid water in it. When this water is stirred up its colour turns red like blood. On the sides of the mountain there are many hot springs; and springs called Yunoheido-kusui, Midagadake-no-yu, Waku-hishi-no-yu, and Tamano-yu contain a quantity of sulphur.

In Ota, a place opposite to Wakuyu, there is a bituminous sort of earth called Yachi-makuso, which takes fire and burns when kindled in spring time. The *Shoku-nihon-ki* says:—In

the province of Echigo the people often gave this kind of earth to their prince as a present.

In the book called *Wakan Sansai-zue* it is said that all the fire which comes out of the earth is produced by Inki (the passive principle in Chinese philosophy). In Asamagadake and Onsen-gadake in Hizen, however, thick smoke is always found and when the burning is violent lava is also ejected. From this it is agreed that the cause of all this is not *inka* (a kind of phosphorescent light) but it is *yōka* (active fire).

It is customary for people in both China and Japan to resort to such mountains as Asama for the purpose of worshipping certain gods. For this reason in Japan there is a temple on Fuji called Sengen-no-yashiro dedicated to a certain god, and in the province of Ise there is a god belonging to Shintōism or Buddhism in the Asakuma mountain.

The *Nihon-ki* says:—In the 3rd month of the 14th year of Hakuho era (685), during the reign of Tembu Tennō, ashes fell down in the province of Shinano and the trees and grass were destroyed. (This was about 1014 years before Temmei). We think that this must have been the eruption of Asamagadake. In the 14th month of the 7th year of the Taiei era (1527) during the reign of Gonara Tennō, Asamagadake is said to have erupted. On the 22nd day of the 11th month of the 4th year of Kyōroku era (1532), during the reign of the same emperors (252 years before Temmei) there was a heavy fall of snow which covered the ground 6 or 7 feet thick, the snow falling till the 23rd. From the 25th to 28th it snowed again occasionally. At this time Asamagadake began to burn and large and small rocks were violently ejected to the distance of 2 *ri*. Among the stones which fell there was a huge rock which was about 42 feet in diameter. It is called Nanahiroishi (7 fathom stone) and it is still seen at this present day. Ashes fell to the extent of 30 *ri*. Now the snow we have spoken about was melted by the heat of the burning materials. The water of the melted

snow, together with the rain which fell on the 27th and 29th, ran down the valleys rolling with it the lava and other material. All the houses that were near the foot of the mountain were washed away and the roads became impassable. The *Daimio* of that province issued an order to the farmers of the neighbouring villages that all persons above 15 years of age and below 50 should work to clear away these masses of *débris*. After four years' work the road was made good. Even now many parts of this district are almost wholly covered with ejected lava. This is the eruption which took place in the 11th month of the 4th year of the Kioroku era, about 252 years before the great catastrophe of the Temmei era. The following are the dates on which the eruptions of Asama took place.

1.—7th month, 8th day, 1st year of Keichō (August 19th, 1596). Many persons were killed.

2.—1st month, 26th day, 2nd year of Shōho (February 22nd, 1645).

3.—1st month, 26th day, 1st year of Keian (February 18th, 1648).

4.—7th month, 10th day, 2nd year of Keian (August 19th, 1649).

5.—3rd month, 4th day, 1st year of Sho-ō (April 13th, 1652).

6.—10th month, 20th day, 3rd year of Meireki (November 25th, 1657).

7.—6th month, 5th day, 2nd year of Manji (July 24th, 1659) much roaring.

8.—3rd month, 5th day, 1st year of Kanbun (April 4th, 1664), also on 28th, 8th month of the intercalary month.

9.—1st month, 1st day, 1st year of Hoyei (January 25th, 1704).

10.—11th month, 18th day, 5th year of Hoyei (December 18th, 1708). Scattered lava as far as the eastern provinces.

11.—2nd month, 26th day, 1st year of Shotoku (April 13rd,

1711). Trembled for some time, after which ejectmenta accumulated in one hour to a height of one inch.

12.—9th month, 3rd day, 4th year of Kioho (October 4th, 1719).

13.—5th month, 8th day, 6th year of Kioho (May 22nd, 1721).

14.—1st month, 1st day, and 7th month, 20th day, 8th year of Kioho (January 25th, 1723). (August 22nd, 1722).

15.—10th month, 14th day, 14th year of Kioho (November 23rd—December 19th, 1729.) Groaning and loud noises.

16.—6th month, 20th day, 18th year of Kioho (July 20th, 1733). The foot of the mountain was burnt.

GREAT ERUPTION OF ASAMA-YAMA IN THE 3RD YEAR OF
TEMMEI (1783).

When Asama-yama is ejecting smoke, it keeps silence, but when the smoke ceases and especially if it is for long periods the mountain erupts. This is in a great measure, due to the accumulation of the sulphur which the mountain contains. The circumference of the crater is about half a Japanese *ri* ($1\frac{1}{4}$ miles English). It is of an unknown depth and is filled with sulphur. About 5 years before the eruption which I am going to describe, it closed itself up and in consequence, it ceased to smoke. In the spring of the 3rd year of Temmei (1783), little by little it again began to smoke. The smoke went towards the west which made the people of the neighbouring villages anxious because, according to their tradition, when the smoke rose toward the west it was a sure sign of dreadful catastrophies. Just as the people anticipated, the smoke gradually increased until at last it assumed such a large scale as had never been seen before. This was from the 6th to the 8th of the 7th month. It first began active eruption about $11\frac{1}{2}$ o'clock on the 26th of the 5th month (25th June, 1783). The column of smoke ascended to the height of one hundred feet and its breadth ap-

peared to be from 20 to 30 ken. The eruption seemed to increase in activity on the night of 18th of the 7th month, and especially from midday on the 29th of the same month it was more active than it had previously been. On the 1st of the 7th month the weather was fine in the morning, but it began to rain slightly in the afternoon between 2 and 4 o'clock. The mountain threw out volumes of smoke more furiously than ever. In the evening it was calmer.

On the next day, that is the 2nd day of the 7th month, it began to burn again about 12 o'clock, but the burning was weaker than that of the previous day. About 3 o'clock it became more active and roaring noises increased. About 8 o'clock it was furious, but stopped about 4 o'clock a.m. (on the next day) when it only groaned. At 6 o'clock p.m. on the 5th a small eruption, which was succeeded by a great noise like thunder, took place. On the 6th it began to burn at about 3 p.m. and by 6 o'clock the burning again became furious and shook the earth. The noise it made was like that of a thousand thunders. To the very foot the whole mountain seemed to be on fire, and from the midst of the smoke lightning flashed in every direction and the smoke rolled away to the north-east for a distance of ten *ri*. The scene was fearful. At midnight the eruption became still more active, and screens in houses 10 *ri* distant were shaken and slipped out of their grooves. The villagers passed the night in the fields, because they were too alarmed to remain at home. In the vicinity of Takasaki mud mixed with ashes fell upon the ground. On the 7th day the inhabitants of Oiwake, Kodai, and the neighbourhood, fled to Iwamura. The people used everything available to protect themselves. At a village called Karuizawa, which was deserted by the inhabitants, ashes fell thickly on the evening of the 7th day.

Many of the escaping inhabitants were wounded by the falling ashes and stones.

In consequence of the falling of ashes and red hot stones,

many of which were one foot in diameter, about 50 houses at the western part of the village of Karuizawa were burned, but no one was injured. On the 13th the people came back to their houses, but the eruption still continued and large lumps of lava were thrown as far as a valley called Mugegatani which was situated on the west side of Asama-yama. In time this valley was filled up with lava and became a hill which was higher than Mayekake-yama. When the column of smoke inclined towards the north-east (? E.S.E.) the ashes and lapilli were carried as far as a mountain called Hanare-yama in the province of Shinano. On the same day *i.e.*, 13th, the ashes fell at 4 o'clock p.m. at the villages of Hirao, Hirago, and Ohigata and also in a river called Yugawa to the east of Kutsukake. Fine ashes fell so thickly in this river that the water became dark coloured and it did not recover its original transparency for more than a year. At Karuizawa the lava was heaped to a height of about 4 feet; at Usuitōge and Shakushi-machi its thickness reached about 5 feet and almost touched the eaves of the houses. Some houses were crushed. At Sakamoto-shuku ashes were piled to a height of about 4 feet, at Miōgisan about $1\frac{1}{2}$ feet, at Yokozawa $\frac{1}{2}$ feet, at Matsuda 2 feet, and at places between Itahama and Takasaki over 1 foot, and finer ashes being carried still further eastward, fell as far as Yedo (or Tōkyō) where they formed a layer about one inch in thickness.

Up the Tonegawa River at Kurihashi and Satte, ashes were about 2 inches thick. In Hitachi, Shimōsa, Chōshi, only a little. At a distance of about 70 *ri* from Asama-yama there was a large pond near the temple of Hadana-yama. The water of this pond was almost dried up at that time. In Joshū and Boshū where the ashes fell, the sky was dark from about 2 o'clock p.m. on the 7th and there was vivid lightning accompanied with frightful thunder. It was so dark that nothing could be distinguished and people were compelled to use lanterns for walking. On the 8th day it was not so dark in the morning, but from 8 a.m. it became again dark. At Karui-

zawa and Okegawa on the Nakasendō, rice and vegetable fields were all levelled and trees and plants were buried under the earth. Dogs, monkeys, and deer were struck dead and many of their bodies came floating down rivers, all of which had no hair left on their skins. The noise of the eruption was heard even as far as Ise and Ōmi, and shaking was also felt at such distances. On the 8th day, before the noise and shaking had stopped, the people offered prayers at temples. From the 8th travellers on horseback, or by *kago* and the like, could not pass along the road.

It was after this great event that the repairing of the road began. On the 1st of the 8th month ten men of Hirao-mura went up Asama-yama and when they returned they told what they had seen. They said that the fissures on Mayekake-yama were very numerous and the mountain was cracked in northern, southern, and western directions. The breadth of the fissures in some places were about 6 inches and in others about eleven inches. From these fissures smoke was issuing previously. Kana-yama was formerly lower than Mayekake-yama but after the eruption it was raised above the later and at the same time it was cracked in several directions. Just below Asama-yama there was a mountain called Sudakake-yama which was once covered with a large wood. When one entered this wood at noon time it was as dark as night. But this thick wood was all burnt to ashes by the falling of hot cinders. As regards the crater there was a fissure on its west and east sides, and the cracks ran down as far as Fumotozawa (a place at the foot of the mountain). The depth of the crater was not known because the bottom was hidden by the smoke which was always coming out of it. There was one large deep fissure 5 *jō* in length at the north side of the mountain.

The time at which these ten men went up to the crater was about 10 o'clock. As soon as they came down which was at 12 o'clock the smoking again became very furious and all the people marvelled at it.

GUSHING FORTH LAVA IN NORTH JOSHIU.

To the north of Asamayama there was a large wood called Nagi-no-hayashi. Its length was about two *ri*. Some of the trees which grew in this wood, were about 5 fathoms in circumference and their height was about 13 *jō*. In this forest an axe had never yet been used. About this time, however, a man came bringing with him many woodmen from other quarters, in order to cut the trees. Now everything was ready to go on with work. On the 8th of the 7th month about 8 o'clock in the morning when all preparations had been completed, smoke and mud were seen to come out from the wood. Trees were rooted up and lava and mud gushed down upon seven villages which were situated near the wood. The height to which the column of lapilli was thrown up, was many *jō*, and the lava and mud ran down in a stream 2 *ri* in breadth. At Naganohara it was 4 *ri* broad. All the villages were quickly covered with mud and lava. The people were numbered at 670 before the event, but those who survived the calamity were only ninety.

The villages of Yamanoyu, Tajiro, and Osasa were not destroyed although situated very near the wood.

Forty-two villages in Azuma-gōri in North Jōshū were destroyed and ground occupied by woods and rivers was reduced to a desert of $3\frac{1}{2}$ square *ri*.

To the south of Kambara a number of huge rocks was piled together to form a huge hill. From a wood called Chinzei-nomori, near a village called Yukidani-mura, a large oak tree, 7 fathoms long, was rooted up. A large number of people, cattle, and wild animals were destroyed. Mud gushed forth through Matsu-no-sekisho as far as the river Tonegawa and buried Goryō-no-seki-sho. The river Tone-shichibu which flowed near Hiratsuka, and also the river Tonesambu which ran in the direction of Goryō and Shingashijiri—both of which are often named Bandō-tarō—were converted into land. In the upper part of one of these rivers, about 3 *ri* from Hiratsuka, fish could be caught by hand. The mud also ran into Mitomo-

mura through the Sambugawa River and buried the villages so deep that the people had to go in and out of their houses from the upper story.

Many persons were starved from want of food, and others had for twelve or thirteen days to sustain themselves by sucking the dress dipped into muddy water.

The villages of Hatchōkashi-mura, Tenjin-mura, and Fujiki-mura were covered with mud and large stones which were piled together to form a heap 30 *chō* in length. The mud being intensely heated it kept boiling for a period of 24 or 25 days. Several other villages were destroyed and a great many animals died. The moats of Mayebashi Castle were also covered with the mud, &c. Subsequent to all this, coins, household property, and other things were taken out of the ruined buildings.

“From the end of last month (6th month) Asamayama began to shake and throw out ashes. On the evening of the 5th, 7th month, ashes were heaped to the height of about 5 inches. They fell most abundantly on the 6th at about 6 o'clock in the evening, and during the same night a great noise was heard. On the 7th at noon it was very dark quite like night and the mountain was ejecting smoke actively. Ashes fell until about 10 a.m. on the 8th when there accumulated 1 *koku*, 5 to 3 *shō* (1 *shō* = 5833 grains troy) of ashes in each tsubo of ground. All cereals were buried and during the whole time it never rained. In the Tonegawa river immense masses of lava remained red hot even in the river itself. In consequence of all this the roads to Kanyagawa and other places and also that to Nikkō were stopped. The mountain pass of Mikunidōri was also stopped.

Those who survived the catastrophe in Kambara-mura only numbered 90. Many fled from the village. At the end of the 8th month the local government called them back and provided them with a large hut, and also gave them 200 *rio* so that they were able to cultivate or reclaim their land and work their rice fields. At this they were very pleased.

Amongst the people many lost their relatives. In consequence of all this, it afterwards happened that a woman married a man who lost his wife and a man married a woman who lost her husband, and so on.

The groaning of Asama-yama ceased about 12 o'clock on the 8th day and became quiet little by little. Nevertheless it perpetually ejected smoke. All are now in safety and peace.

HIGH PRICE OF CEREALS, &c.

When the great eruption of Asama-yama ended, smoke continued to issue from the crater in every direction. It was at times so thick that the blue sky could not be seen. In Joshū and in some parts of Shinshū, momo trees (peach), cherry trees, the wisteria, and mulberry trees blossomed and bore fruit as if it were spring time. At this the people wondered and their minds became restless. During this month the weather was often cloudy and much rain fell. In consequence of this, vegetables did not grow very well. In order to obtain food the people gathered the shepherds-purse and plucked the leaves of *azuki* (a small red bean) and *daisu* (a large bean of black or white colour). Along mountains or hills people ate *tokoro* and similar vegetables. On account of all this the price of grain became very high and the poor people were unable to live, and thousands of half-starved men gathered together and destroyed the houses of the richer people for the purpose of taking their rice.

During this year and the following (4th year of Temmei) famine prevailed in these two provinces and neighbouring ones. By this second calamity many souls perished, although the government made every effort to save them from starvation.

Another account of Asama runs as follows:—

The slope of Mount Asama is about four and half *ri* in extent, and smoke always comes out from it. The burned stones lying on its sides are like pumice stone.

On the 8th of 4th month of every year, all men of the neigh-

bouring villages, after cleansing themselves, ascend the mountain as a rule. In ascending each person takes a bamboo pipe with him for carrying water. This is required to wet his straw sandals for the purpose of keeping them from being burned.

A TRUE RECORD OF THE WONDERFUL EVENTS WHICH HAPPENED
IN THE YEAR OF TEMMEI, 1782, FROM THE "TEMMEI
CHIMJUTSUKOKU."

When Asama-yama in Shinshū first began to burn is unknown, but it is thought probable that it burst out about the 1st year of Temmei (1781). It was then very powerful and violent. In the spring of the 3rd year of Temmei (1783) it became still more powerful and hot, and the people of the neighbourhood thought that a fire had broken out near them. For many days in the summer of this year (1783) there was much rain, and it was very unusual to have clear weather. For two days, the 7th and the 8th of the 7th month, this mountain shook and roared very violently and flames were thrown out. The two villages, Oiwake and Karuizawa, at the foot of this mountain, were covered with melted lava, and also the places, Usuitōge, Sakamoto, Annaka, Miogi, &c., severely suffered. All the mountains to the east of Karuizawa began to blow out flames, and several villages, places covered with wood, &c., were burnt or became loose like marshes and gradually ran away. Seeing this the people were greatly frightened and tried to go up into the mountains or to retreat into woods in order to escape from this terrible destruction. But they could not all escape and a great many were buried in the hot loose ashes. It was a very gloomy state. Sometimes a great many large stones, from 8 or 9 *ken* in length to 10 or 30 *ken* [about 48-54 feet by 60-180 feet] in thickness, were thrown up in the air, like leaves of trees. As soon as these stones dropped on the surface of the land they melted away and ran about. It was very difficult to avert calamities like this with human power. The number of the people and animals which were destroyed was very great.

The destruction was rather small and weak in Shinshiu, but was very violent strong in the eastern parts of Asama-yama.

At this time Jōshū suffered greatly, and on part of the boundary line of Jōshū and Shinshū so much sand fell that it reached to the height of 1 *jō* and 4 or 5 *shaku* [about 14-15 feet]. In the neighbourhood of Usui it was particularly great, and even in the very precipitous hollow place called "Hanneiseki" there was so much ash that it seemed like level ground. In the villages, Annaka, Matsuida, Kuragano, Takasaki, etc., the sand was heaped up to the height of 5 or 6 to 8 or 9, *shaku* [*shaku*=about one foot]. In Musashi, Shimōsa, Kazusa, Hitachi, Shimotsuke, etc., it was also very remarkable. In the villages, Honjō, etc., on the boundary of Musashi and Kazusa, the night and the day were equally dark. This lasted for two days and no one knew when it was day break. The earth shook very violently and the doors and the windows were opened. No one could tell anything and there was only silence in the houses. It was unexpected that any one should have been left alive. When the people saw and worshipped the sun they thought that they had risen from the dead or awoke from a dream. There was no distinction between the roads and the fields. In Kuragano (a village in Jōshū) a large stone, 44 *ken* long and more than 20 *ken* wide [264 × 120 feet] fell in a river and it seemed like an island. Not only this large stone, but also many other large ones dropped as abundantly as the leaves of trees.

At this time the colour of the waters which were carried into the river Tonegawa by this accident, made them appear as if they carried some poison, and on account of the strength of the water a great many dead people and animals and cattle were carried away by this river. By the order of the government all the dead bodies were taken up from the river and buried. In consequence of the poisonous nature of the water a great many fish of various kinds became sick and went slowly floating down on the surface of the water. They could

be caught with the hand and they were brought into Yedo, and everywhere in such quantity that the price of fish was very low. But the people who ate these fishes, were said to have become sick themselves.

As it was unknown how far the destruction had extended, some of the people in Shinshū went to Joshū and there they saw many dead people. Some had been killed by stones, some had died in a marsh and only their heads could be seen, some had died holding on to trees or bamboos. Everything was in a very dreadful state.

I was told by an old man that "In ancient times, in the year of Hoei (1707) there was an eruption of Fuji-yama and the ashes fell on all the neighbouring countries. Yedo was then quite dark for one day and one night: but melted lava had not run here and there like the streams at the time of the eruption of Asama.

Yedo began to shake and a roar to be heard in the dawn of the 7th day of the 7th month of the 3rd year of Temmei (1783). It was very cloudy all day. Particularly in the north-western part of Yedo it was very dark, and the noises like those of thunder were very frightful. In some parts of Yedo ashes fell down and accumulated to a thickness of about 2 *sun* [*sun* = 1.2 inch]. It was very different when the wind changed. The doors and the *shōji* (paper doors) of some of the houses came out by the shaking.

The various events which happened at this time could not be described with the pen nor could they be told with the tongue. At this time, the Kantō (eastern countries) and Ōu (north-eastern countries) had bad crops and famine was universal. It is said that the shaking and the noises extended to the Gokinai (Yamashiro, Yamato, Kawachi, Izumi, and Settsu), the Tosando (Ōmi, Mino, Hida, Kōtsuke, Shimotsuke, Mutsu and Dewa) and the Saikaidō (Chikuzen, Chikugo, Buzen, Bungo, Hizen, Higo, Hyuga, Ōsumi, Satsuma and Iki), &c.

In both the 5th and 6th months during the summer of the

6th year Temmei (1786) it was always rainy weather and then there were no dry hot summer-like days. Some of the people talked with each other about this very pleasant weather and the general coolness. Some of them in consequence of the unusual state of the weather were afraid lest some calamity should fall upon them. At times it was so unpleasantly cool that persons who had to put on dresses of ceremony had to wear under the single summer clothes double winter clothes. Every day it rained heavily. Particularly during three days, the 14th, the 15th, and the 16th days of the 7th month, the rain was exceedingly great and it was quite impossible to go out of doors. On the morning of the 17th day, the water began to overflow Koishikawa, and in the Mitoyashiki, boats had been used. This flood quickly extended and the waters at last ran into the river Kandagawa. It was reported that the two bridges, Shoheibashi and Sujikaimitsuke, were about to be swept away.

All the places near the well Kaga-ido (near the Mito Yashiki), and the Hirokoji (name of a wide road), &c., were changed into rapids, and people who went there to see the flood were drowned in large numbers. Onarikaidō, Shitaya (neighbourhood of Uyeno), Minowa, behind Uyeno, &c., were also converted into rapids and the people could not communicate with each other.

About 6 years ago the mountain made a peculiar jarring sound, and much steam was given off. The people feared an eruption but all passed away quietly.

The plain between Kutsukake is strewn with large blocks of rocks which were probably thrown from the summit of Asama at the time of the 1783 eruption.

The height of Asama is about 8,500 feet. Satow gives the height as 8,282 feet.

When the mountain erupted in 1783 it is said that the waters at Kusatsu suddenly became so hot that the bathers perished.

It was in 1783 that the remarkable lava flows at Skaptar Yokul in Iceland took place.

In 1870 there was a considerable quantity of volcanic material thrown out of Asama.

The diameter of the crater is, according to Marshall, about 600 feet. According to Satow $\frac{3}{4}$ of a mile and according to Von Drasche 3,280 feet.

Amongst the mountains near Asama are Hanare-yama, 15 *chō* to the N.E. from Kutsukake, in which there is a small cave. In ancient times the people of Kutsukake say that this hill emitted smoke. Koasama is a small conical hill at the foot of the steep ascent at Sainohara on the way up there is an old crater filled with water. Near here steam still escapes. Sanbogamine is a group of cones with lava streams. On the top of Asama there are several large fissures. The lava streams running to the S.W. are mostly covered with shrubs and grass and are therefore in all probability older than those running to the north which are bare and rugged. The lava stream of 1783 looks like a huge black serpent clinging to the face of the mountain. The vapours from the crater are exceedingly pungent, probably containing hydrochloric acid and sulphurous anhydride. They even give a strong taste to the snow across beds of which they are constantly drifting.

Landgrebe basing his observations on Titsingh says that the eruption of Asama-yama in 1783 was one of the most frightful records that we have in the natural history of volcanoes. The lava stream which accompanied this eruption is to be seen on the north-side of the crater. Dr. Naumann gives a drawing of this flow, the length of which is 63 kilometers. It runs first N. N.E. then to the N. in the valley of the Adzuma-gawa continuing until it reaches the Tone-gawa. It flowed from Kumawara to the Tone-gawa in 6 hours. The distance being 12 *ri* or 48 kilometers, give an average rate of 3 kilometers per hour. The rate at which it descended from the summit is not known (Naumann). I ascended Asama in 1877 and

again in 1886 from Kutsukake a village on the S.E. side of the mountain. From this side Asama shows a slope of 28° on the North side and 15° on the South. At the base of Asama there are several small hills some of which are probably parasitic cones.

A remarkable feature connected with Asamayama is the depth of its crater. Mr. Edwin Dun and others who have had opportunities of looking down the crater when comparatively little steam was escaping are of opinion that the crater is at least several thousand feet in depth and perhaps as deep as the mountain is high above the surrounding plain.

ASAMA-YAMA.

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Un- known.	
687													—	Eruption.
1124													—	Eruption.
1126													—	Eruption.
1527													—	Eruption.
1532	4													Eruption.
1590				19										Eruption.
1645		22												Eruption.
1648		19												Eruption.
1649								19						Eruption.
1652				13										Eruption.
1657											25			Eruption.
1659							24							Eruption.
1661				4										Eruption.
1704	25													Eruption.
1708													18	Eruption.
1711				3										Eruption.
1719										4				Eruption.
1721					22									Eruption.
1723	25													Eruption.
1729											23			Eruption.
1733							20							Eruption.
1783						25								Eruption.
1869														Eruption.
	3		2	—		4		1	1	2		1	4	
	5			6			3			4				

Winter months 9
 Summer months 9
 Unknown 4

YAKE-YAMA (ECHIGO.)

In 1875 this mountain is said to have been in a state of activity (Marshall.)

HAKUSAN.

This mountain is said to have been in eruption in the years 1839 and 1554. The height is according to Atkinson 8,990 feet; according to Rein 8,912. On the top there are three tarns formed in hollows along the lip of what may have been an old crater.

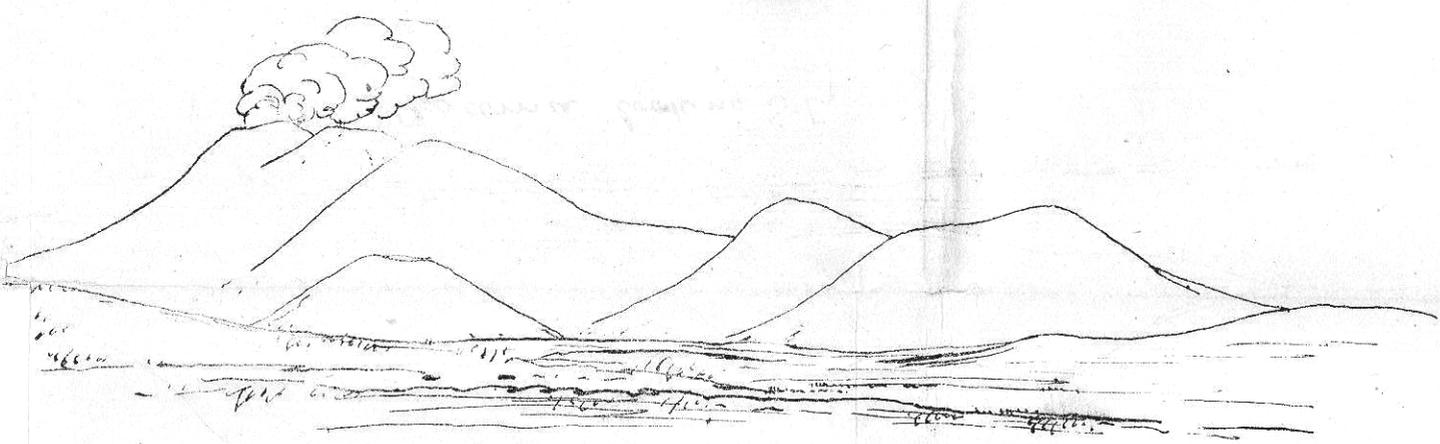
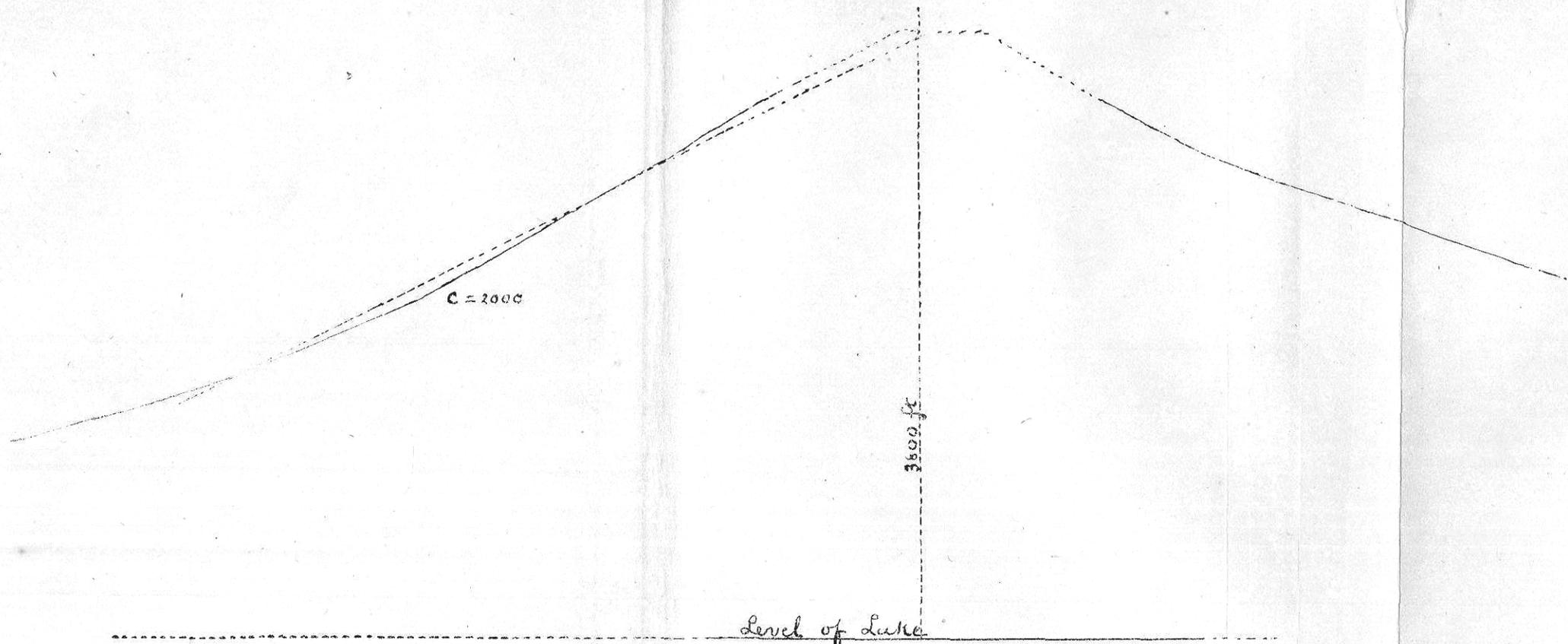
TATE-YAMA.

It is said that during the 1st year of Keiun, Daiyei-dake on the N. W. of Tateyama was in eruption. The crater of the volcano is at present 18 cho in length and 5 cho in breadth. Many hundreds of holes like this are found each throwing up highly heated water from 3 feet to 15 feet above the surface of the ground. It is of a grey colour and the smoke from it rises to the height of 50 feet or more. Detonations are to be heard for a distance of 7 or 8 cho, and the holes continually change their position and their size. They all give out vapours of sulphur.

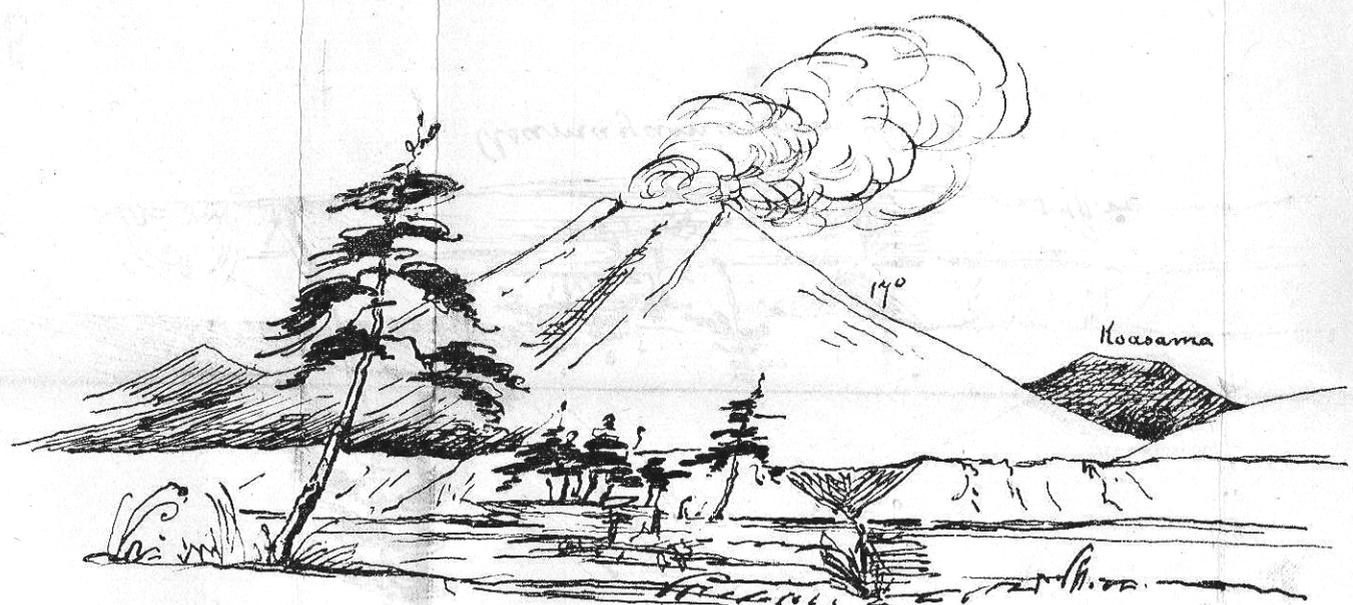
The height of Tateyama is about 9,500 feet. Near the top there are mud and water springs all boiling, some of them with violence. The place where these occur may have been an old crater.

SHIRANESAN (KUSATSU).

On the top there are two lakes one of which is black while the other which is lined with sulphur is of a light blue colour. These lakes together with a small pond represent three craters. The height of Shirane is about 6,500 feet. Sulphur is collected from the mud round the lake, (Marshall). The above three ponds or lakes are contained in a large crater measuring about 500 yards by 100 to 150 yards. The height is about 6,500 feet? In the summer of 1882 there was a sudden eruption of mud and hot water from one of these ponds. In November of the same year steam was still issuing. There is another peak near here called Moto Shirane which is also volcanic (Satow).



Asama looking S.E.



Asamayama from the S.

THE NIKKŌ DISTRICT.

SHIRANE-SAN AND NANTAI-ZAN.—(*Plate 5.*)

Chūzengi is the name of a lake lying about 70 miles North from Yedo in the province of Shimotsuke. A few miles from Chūzengi are the famous temples of Nikkō, one of the best known and most celebrated places in Japan. On the shores of lake Chūzengi there are the volcanoes called Shirane-yama and Nantai-zan. The former of these shews a well defined logarithmic curvature and by its shape alone testifies to its recent formation. The latter mountain, Nantai-zan, is not so well formed and at the top it is quite rounded and without any signs of a crater. The appearance which this mountain presents when viewed from the bottom is in fact similar to the appearances which are presented you on reaching the summit. Here and there you find traces of old lava streams. Both of these mountains have been ascended by many foreigners.

The height of Shirane is given at 8,800 feet whilst the latter is 8,150 feet. At the time of my visit the rainy state of the weather prevented my attempting to make an ascent, and the little information which I collected respecting them has reference rather to the rugged mountain group from which they spring rather than to the volcanos themselves.

As might naturally be expected the Nikko mountains form a region of great disturbance, and every visitor to the district lying between Nikkō and Chūzenji cannot fail to be forcibly impressed with the rugged grandeur of the scenery with which he is continually surrounded. The mountains are high and irregular, whilst the valleys which separate them are deep and gorge-like. In many places steep walls of rock have been formed, and over these where they cross a river bed we often see one of those cascades of water which form one of the principal sights of this interesting district.

At almost any of these waterfalls and along the beds of the

various mountain currents which course this district vast exposures of the rocks which build up the mountains can be seen.

The rock appears everywhere to be andesitic and of the usual bluish grey colour. Distributed through this there are often small grains and crystals of an opaque white felspar.

In addition to this rock, but occurring only sparingly, there is another felspathic rock which is almost white. The colour of this is apparently due to the large quantity of white felspar and grains of quartz it contains. The forms of these minerals is often seen in well defined crystals an inch or more in length. Many boulders of rock showing this well defined porphyritic character may be seen lying in the bed of the stream running between Nikkō and Chūzenji. In many specimens of this rock small well defined crystals of hornblende are to be observed. Where these have been crystallized the rock has assumed a slightly greenish tinge. Lying above these rocks and forming the lower part of the soil from which the vegetation springs are beds of scoria, pumice and other volcanic ejectamenta forming beds which in many places must be several hundreds of feet in thickness. These materials are of varying size; sometimes you see large boulders several feet in diameter and at other times fine ashes. They evidently represent the accumulation from eruptions which have been both violent and of long duration. Where these materials have been decomposed, a clayey soil has been formed, a very good example of which may be seen on the latter part of the road before reaching Chūzenji Lake. These beds of ejectamenta extend over a large area in various directions from the centre from which they apparently have emanated. The farther we recede from Chūzenji, the thinner do they become, and the materials of which they are composed are finer. I first observed them in the banks of the road between Utsonomiya and Imaiichi. Here they are several feet in thickness, and the component materials will average $\frac{1}{2}$ inch in diameter. In places they are partially decomposed, and from the oxide of iron which has been

formed have assumed a red colour. Lying above them there is a bed of vegetable earth 2 or 3 feet in thickness and out of this near the roads spring tall *Cryptomeria Japonica*. These trees are usually about 4 feet in diameter near the base, but many of them will exceed 6 feet. I refer especially to these trees, as they give us a means of roughly estimating the number of years which have elapsed since the formation of the stratum of ashes on which they have grown and into which they penetrate. If we assume that the superincumbent layer of vegetable earth was formed whilst the trees were growing, the age of the trees will give us the least possible period which can have elapsed since the last great eruption in the district of Chiuzenji. If these trees have grown subsequently to the formation of the vegetable earth this period must be considerably increased—perhaps doubled, or even quadrupled. I again observed these beds of ashes when travelling Northwards from Imaichi, towards Wakamatsu, on the banks of the River Daigawa.

Here the section as exposed in the river bank was 3 feet of black earth, 3 feet of white pumice, and 3 feet of red pumice. This pumice was about the size of walnuts. The earth forming the upper part of this section shows that it is a long time (that is historically) since the ashes which lie beneath it were thrown out. The difference in character between the two beds of ashes may indicate two periods of eruption. The size of these particles and the distance they are from their origin tell us that the eruptions were violent. At many other points along the river and the road I saw similar sections, and in travelling from Imaichi towards Nikkō, these beds can be traced toward their origin.

This group of mountains forming the Chūzenji and Nikkō district appear on their southern side to be directly overlaid by the tertiary tuffs which bound the Yedo plain. The low hills which these tuffs form can be seen in the neighbourhood of Utsunomiya, where they are quarried as a building stone. They are here fossiliferous.

Shiranesan was in eruption in June, 1872. The height is about 8,500 feet. The crater is irregular and contains depressions filled with water (Marshall). According to Satow there was an eruption in April, 1871, and another in 1649. The height is 8,800 feet. On the top there are several small craters. A ridge called Mayijisane looks like the ruin of an enormous crater. At the North end of this there is a pond of a remarkable green colour.

Nantaizan has probably long been inactive. Although it has a well defined volcanic form, all traces of a crater at its summit have been obliterated. It rises about 3,800 feet above the lake of Chūzenji, or about 7,800 feet above the sea (Marshall).

According to Satow the height of the lake is 4,375 feet, and the mountain 8,150 feet above sea level.

BANDAI-SAN.—(*Plate 6.*)

Bandai-san forms the terminal peak of a small block of hills lying on the northern side of Lake Inawashiro. When seen from Wakamatsu or from any point on its S. or W. side it stands up as a conspicuous peak. Nowhere, however, does its shape show any curvature or outline by which its volcanic origin could be inferred. This would seem to indicate that since the time when this mountain was in a state of activity a considerable period has elapsed, during which degrading forces have been actively at work. It can be ascended from the side of Wakamatsu. An old Japanese calendar stated that Ban-dai-san was formed in the year 807. In these hills, from which Ban-dai-san rises at Higashi-yama there are some celebrated hot springs. On the flanks of Ban-dai-san itself there are also hot springs. These apparently indicate the volcanic nature of the region. From Wakamatsu I travelled a few *ri*, over an andesite country to the village of Hagita at which place I obtained a guide and commenced the ascent. The first part of the road was in a N.N.E. direction over a plain covered



Iwakisan from near Matsumai.



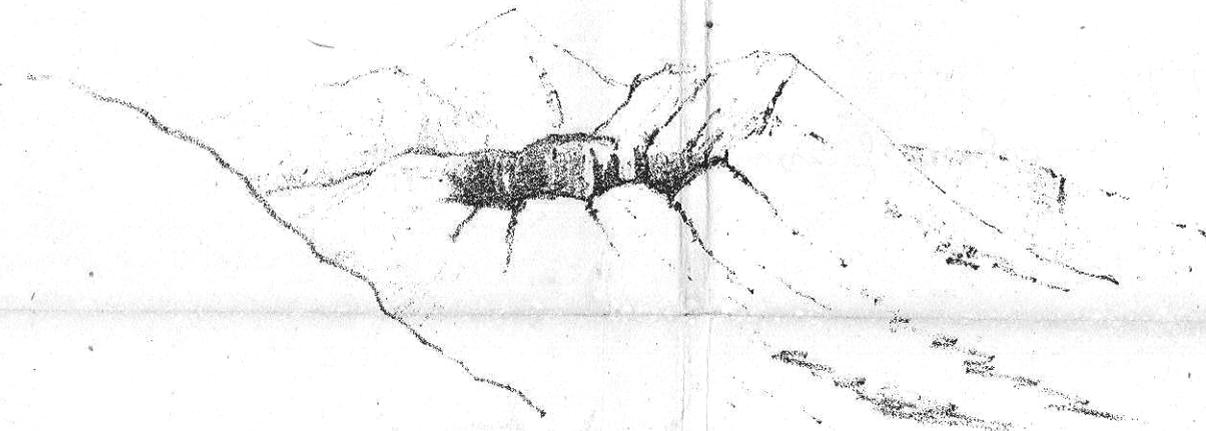
Oyama

Looking S by W from near Esan

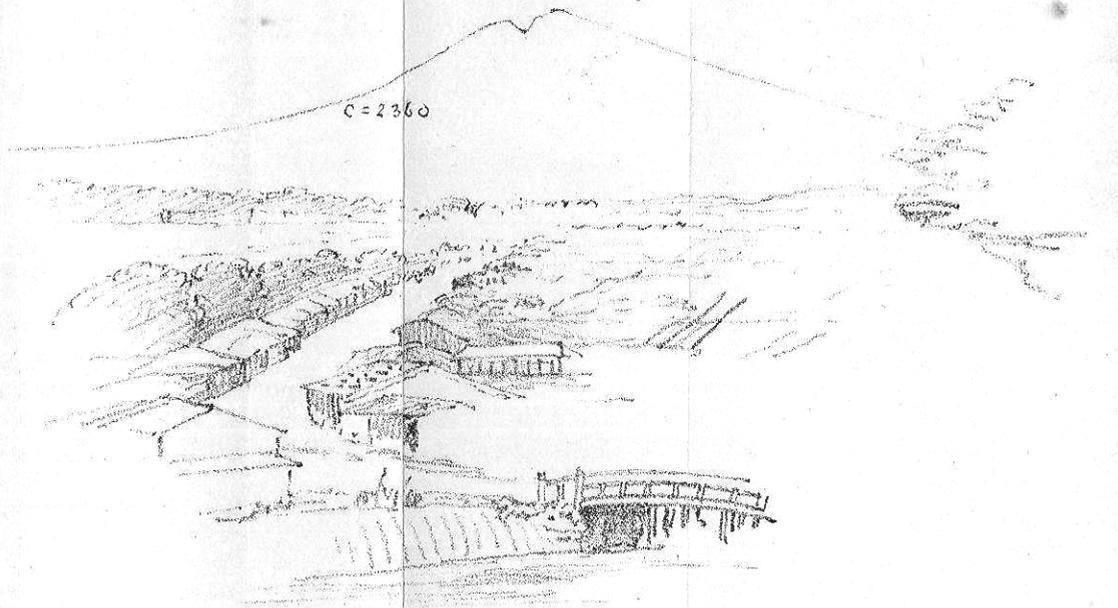
Chokaisan from the West.



Ganjusan from the South

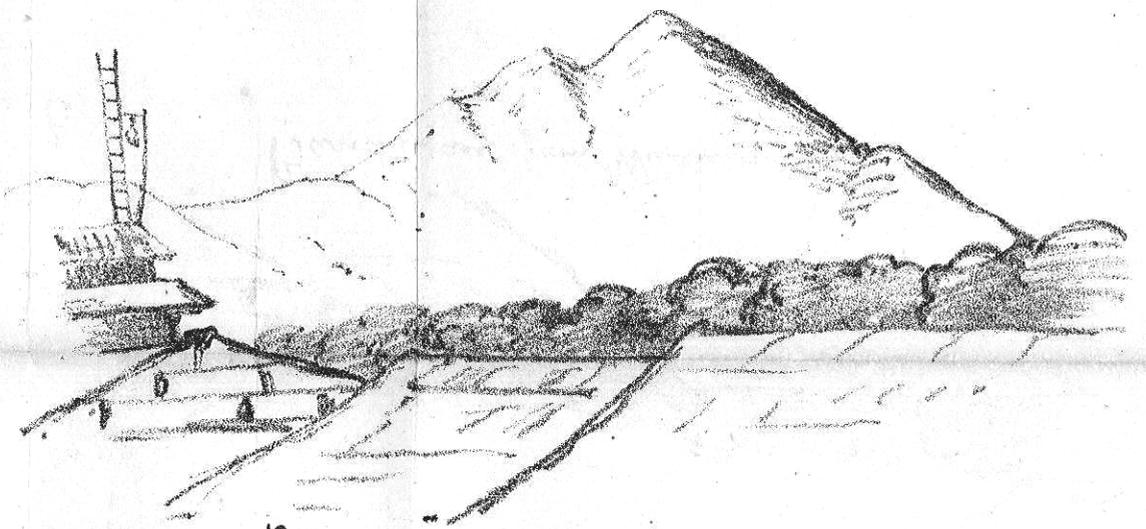


Upper cone and crater of Ganjusan.



C-2360

Iwakisan outline from a photograph.



Bandaisan from Wakamatsu

with long grass, and a few small oaks. The path sloped gently upwards. Looking towards the right on the South slope of the mountain there is a small red hill from which an old lava stream appears to have flowed? Looking back you see Bandai-san separated from the shore of the Lake by a flat plain which is evidently the result of filling up by a delta like accumulation of sediment washed down from the mountain. After $1\frac{1}{2}$ hours I reached the foot of the first steep slope. At this point I observed rough scoriaceous rocks sticking up through the grass, evidently the out-crop of an old lava stream. I say that it is old, first on account of the quantity of earth and grass which covers it, and secondly on account of its weathered appearance, decomposition having reached several inches into the interior of the stone. This point is about 1,400 feet above Hagita. In the distance towards the S.W. rising above the rugged ranges of mountains which form the line of the horizon two truncated cones can be seen. (They are probably volcanic and lie near Nagoka). Towards the W.N.W. there are four ranges of mountains apparently running from N.N.E. to S.S.W. The first of these ranges is apparently the lowest, whilst the most distant one is the highest. To the N.W. are the Haida mountains which were covered with patches of snow. Beyond this point the climbing was exceedingly difficult on account of the steepness of the slope. This upper slope as measured from a distance was 35° . After $3\frac{1}{2}$ hours from starting we reached the summit, which is a sharp peak, about 5,100 feet above sea level, on one side terminating in a precipice-like descent.

Our descent was to the town of Inawashiro. On the following day we travelled round the side of Bandai-san until at Osawa we joined the main road leading to Yonesawa. Our path was altogether over grassy slopes which form this side of the mountain and nowhere could any exposures of rock be seen.

From the hot springs, the scoriaceous appearance of the old lava streams, and the tradition in the neighbourhood that the mountain was once in a state of eruption, I shall class this mountain amongst the group of still active volcanoes.

CHOKAI-SAN. (*Plate 6.*)

Chokai-san is situated in Akita ken, about 30 miles northwards from Gasan from the top of which mountain it can be easily seen. When approaching it from this side it stands up boldly. Its sides have apparently the true volcanic curvature, but when looked at carefully they are seen to be furrowed and somewhat rugged. If it is looked at from the North it forms even a more prominent object than it does when regarded from the South.

I made the ascent of Chokai-san on 30th July, 1877, starting from Fukaoura, a small village lying on the sea coast, about 13 miles to the north of Sakata. Setting out at 5.30 a.m., on horseback, our way led through a wood gradually rising towards the first of a series of terraces which fringe the bottom of the mountain. These terraces look very much like old lava streams which have been grown over with a covering of vegetation. Here and there, sticking up through this covering, large blocks of stone very much like old ejectamenta can be seen. At 8.30 we had travelled about 7 miles and were fairly at the foot of what might be called the steep part of the mountain. After an hour's steep climbing we reached a heap of stones called Otaira (the plain). Some of these I observed were scoriaceous. After another hour's scramble up a pathway, which was not unlike a very rough steeply inclined clayey drain, we were on the top of a second ridge. Here we found the first snow field (4,800 feet), by the side of which there was a small hut for the accommodation of pilgrims. From this point our path lay up a green slope. On reaching the top of this we found ourselves upon the rim of a huge crater (4,900 feet). The sides of this crater, which is 80 or 100 yards in width, are green with grass. Rising from the bottom of this there is a small cone about 400 feet in height, at the base of which there is a pond or lake. Turning towards the right along the rim of this crater the path leads upward towards the main peak of Chokai-san. This is rugged, stony, and of a red colour. Through a breach in its side it shows the

walls of an old crater. In the side of this breach there is exposed a section which show the general structure of this upper cone. This shows a stratified series of crumpled rocks dipping downwards at an angle of 25° . We next turned to the left by a steep pathway down into a stony valley leading up to the breach. We were now fairly above all grass, and to the right and to the left of us were great cliffs and blocks of a grey andesite. From here until we were right up into the very bottom of the crater the path was over beds of snow. The crater itself looked like a high circular stone quarry the sides of which were stratified. After about half an hour's climbing, over a steep slope of boulders, at 1.30 I reached the rim of this upper crater, which I made to be about 5,900 feet above sea level. Here I found several pilgrims, two priests, and a small temple. Before I was allowed to eat the provisions which I had brought with me, the priests insisted on my taking a sacrament in their temple. As the service proved to be short and included the drinking of several cups of wine which had been dedicated to the gods, the ceremony was more refreshing than I anticipated.

I left the summit at 2.10 p.m., and at 8 p.m., after 14 hours hard climbing, reached my starting point.

In travelling from here northwards we crossed several old lava streams descending from the slopes of Chokai-san. Before reaching Hirasawa I saw many large green mounds. Some of these were conical, while others were hemispherical. It is possible that they were heaps of ejectiona from Chokai-san.

When looked at from the S.W. the right hand side of the mountain has an average slope of 15° , the upper portion being inclined at about 26° .

GANJU-SAN. (*Plate 6.*)

This is a fine, well formed volcanic cone, lying to the N.W. of Morioka. In 1877 I ascended this mountain from Suzukiishi, a small village about 12 miles distant from Morioka. On the sloping ground at the foot of the mountain

there are many small, conical hills. The first part of the ascent is up a clayey pathway through woods, after that is a stiff climb over lava and scoria up to the edge of the first crater. Here you descend to commence a second ascent up a steep slope of scoriæ to the upper crater, in the middle of which there is another small cone. This is still steaming. The height of the mountain is about 6,300 feet. Ganju-san is the highest mountain in Iwate-ken. It is situated near the Yosegi, Hirakasa, Takizawa, and Naga-yama in Iwate-gōri. Its distance from Morioka is little over three miles.

On Jōkyō 3rd year 2nd month 29th (February 23rd, 1686), the sky became very dark and during the night an ash coloured snow fell. The sky remained dark until the 1st of the following month. On the 2nd in the morning an earthquake was felt. This was accompanied by a thunder-like noise. Almost instantly the river Kitakami was flooded and many houses and big trees were washed down. On the evening of the 3rd, the sky became clear and a dense black smoke, and vivid flashes of fire were observed playing on the top of the volcano. This was accompanied by a crackling sound. On the 5th this ceased.

Ashes fell upon all the neighbouring towns and villages and the ash was very painful to the eyes, the nostrils, and the mouth. No one could stand outside his house. In the villages which were within the distance of two miles from the mountain many houses were crushed and extensive rice fields were covered with ashes and in places even with red-hot lava. It was said that three years previous to this event all the fish in the river Kitakami had suddenly disappeared.

During Bunsei 7th year 9th month 20th day (November 13th, 1824), the mountain began to make a thundering noise which continued for three days. The source of the noise, however, was not quite certain. It may have been Ganju-san or some other volcano.

IWAKI-SAN. (*Plate 6.*)

This mountain, which is situated near the northern extremity of Nipon in Awomori Ken, is sometimes known as Tsugaru Fuji or the Fuji-yama of Tsugaru. It has been thus called on account of its similarity in form to the famous Fuji-yama which excels all others in the elegance of its outlines. One of the best views is obtained of this mountain when looking at it from a North-westerly direction, whilst approaching Hirosaki from the South. In this direction it is seen rising up from a plain of rice fields, and its solitary grandeur equals, even if it does not surpass, that of the mountain after which it has been named. From Shinozaki I went to Harakisawa, a distance of about 7 miles, from which place I ascended this mountain on the 5th of August. From here its sides are seen to be furrowed, and verdure appears to cover it up to its very summit. Harakisawa lies close underneath the mountain. Here there is a temple where the priests living on the reputation of the mountain have their residence. As the season at which pilgrims are allowed to make the ascent of this mountain is fixed, and as it would be several days before this season opened, it seemed at first a matter of doubt whether I should be permitted to gratify my curiosity by climbing up its sides. This difficulty, however, was overcome by my taking a guide from the temple to whom it was arranged I should make a liberal allowance for his trouble. The first part of the road led for about half a mile through the wood at the back of the temple. Beyond this there was a mile of gently rising grassy plain. This brought us to the steep portion of the ascent. After about an hour's climb we turned to the right across an extremely steep slope covered with alders, until we reached a stony gully. This was filled with large boulders, over which the climbing was somewhat difficult. At its upper part there were several beds of snow. All the rocks appeared to be a bluish grey andesite. At the top of this, at a height of 4,100 feet, we reached a crater, conical in shape and about 100 yards in width.

On the side of this there is a rough stony wall, with a surface which looked scoriaceous. The other sides were covered with grass. At the bottom, there is a small pond about 20 yards in width. From here there are two steep ascents over boulders and gravel in order to reach the highest peak. This I made to be 4,650 feet. Scattered over the top there are many huge andesitic boulders, two broken down sheds, a box containing a stone god, and three or four wooden *torii* (gateways). Lower down the mountain I had seen several beds of whitish pumice, but from the highest parts of the mountain had this ever existed it has probably been all washed away. The ascent and descent was made in about $5\frac{1}{2}$ hours.

When we look at this mountain from the S.E. its left hand side has a general slope of 27° , whilst its right hand side has only 17° . The top part has a slope of 32° .

This is extremely steep, and, from what I saw whilst climbing it, appears in a large measure to be due to the washing away of the covering of ejectiona and leaving only the solid rock.

Notwithstanding that there has been so much degradation taking place upon the upper part of this mountain, its general form and the existence of beds of pumice, indicate that it has been in a state of eruption during periods which, from a geological point of view, are quite recent.

The following information about Iwaki-san has been collected from a variety of sources, partly from books and partly from people :—

In Keichō, 5th year, 1st month, 8th day (Feb. 22nd, 1600), a portion of the mountain called Iwaki-san was cracked and it shot out smoke, dust, stones, and an immense quantity of water, making an enormous roaring. On the morning of 6th month, 13th day, a severe earthquake was felt and it became dark. Small stones were thrown in all directions, and for three days we could not tell the difference between day and night. On the 15th the sky became clear and we had a view of Iwaki-san. Its

southern portion was seen to have been destroyed by the eruption. At Tsugaru-gōri a big earthquake had occurred. This was in the period Shō-ō, 2nd year, 12th month, 18th (Feb, 5th, 1653). Strong evidence is procurable showing that Iwakizan is a volcano, and there is a hot spring in the valley on the south side of the mountain. On the boundary between Tsugaru and Nambu there is a high mountain named Koda ; numerous hot springs are met along the sides of this mountain. Though eruptions have not been heard of in this region, it is evident that the district, which has many hot springs, must be volcanic. The district which is here referred to includes large and small hot springs altogether over ten in number.

During the period Genroku, 7th year, 5th month, 27th day (June 19th, 1693), severe earthquakes were felt thirty times in one day and the ground was split and from the holes sand was ejected.

Hō-ei, 6th year, 3rd month, 14th day, April 12th, 1709, Iwaki-san began to burn.

Meiwa, 3rd year, 1st month, 28th day (March 8th, 1766), a severe earthquake was felt, there being twenty shocks and shakings until the next morning. The number of people killed under destroyed houses, &c., was 1,014 ; by conflagration, 301 ; by land slides on the mountain side, 9 ; wounded, 153. On the 3rd month, 8th and 13th, a great earthquake was felt. Small earthquakes continued from the 28th. During this year the ground was shaken four or five times in every month.

On Temmei, 3rd year, 2nd month, 10th day (April 12th, 1782), smoke issued from the south side of Iwaki-san. The local officers ascended the mountain to make observations on this, and they there saw a great number of smaller holes. They felt suffocated with the vapour of sulphur, and felt the underground detonations.

In Kansei, 6th year, 3rd month, 4th day (April 3rd, 1794), Iwaki-san again burned, and also in Bunkuwa, 4th year, 2nd month, 23rd (April 1st, 1807).

Kōka, 2nd year, 3rd month (March 24th, 1844), the middle portion of the south side of Iwaki-san smoked, and thunder-like detonations were heard. On this occasion an immense quantity of hot water ran down from the mountain, and in many places flour of sulphur was deposited on the rocks. In the same year, on the 8th month, a roaring sound was heard beneath the ground, and the sulphur and smoke which commenced in spring yet continued.

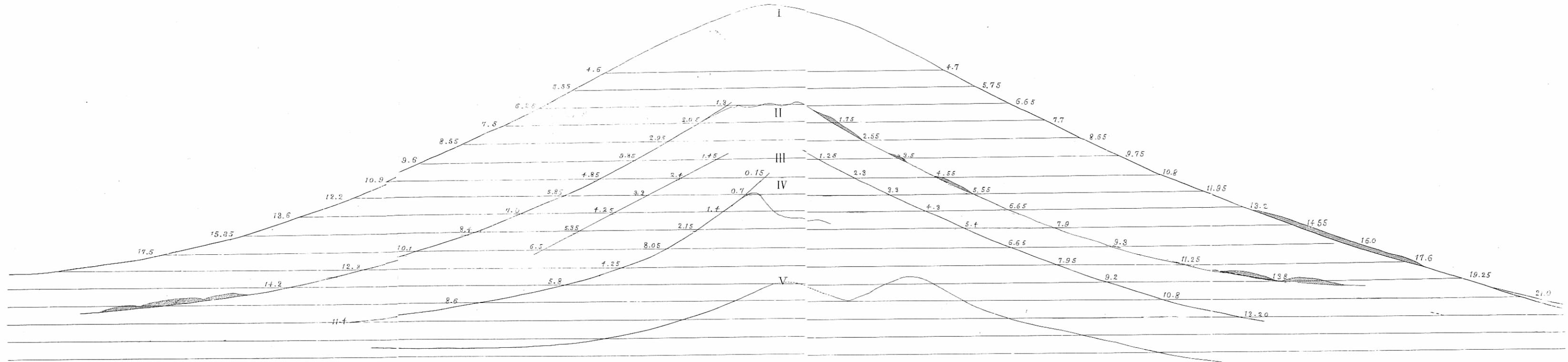
Kōka, 4th year, 12th month, 8th (January 13th, 1848), at midnight a severe earthquake was felt. This was like the one which occurred in the year Kansei.

IWAKI-SAN.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Un- known.	
1600.....		22												Eruptions.
1700.....				12										Eruptions.
1766.....			8											Eruptions.
1782.....				12										Eruptions.
1794.....				3										Eruptions.
1807.....				1										Eruptions.
1844.....			24											Eruptions.
1848.....	13													Eruptions.

VOLCANOES OF YEZO.

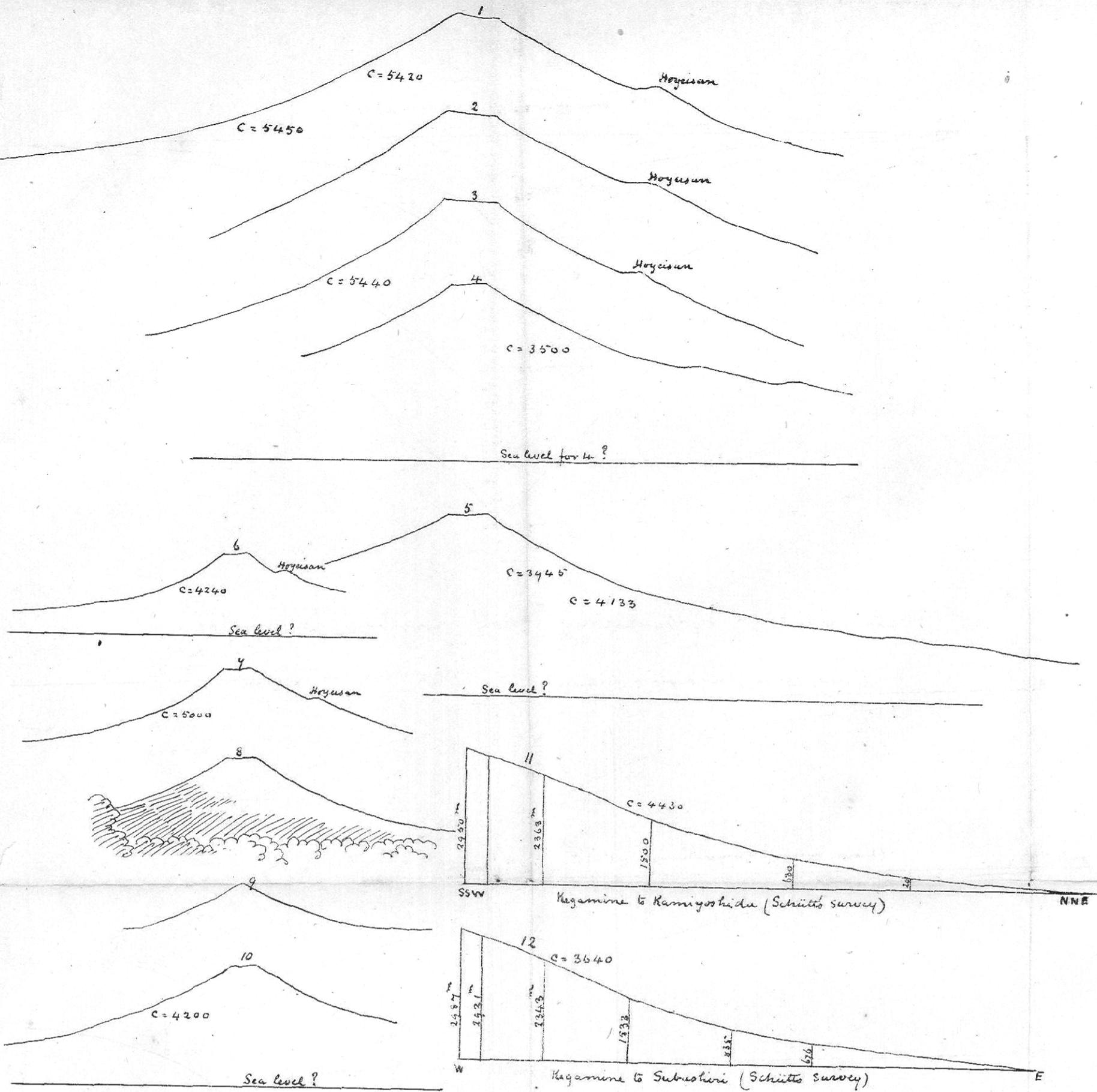
The volcanoes in Yezo which I have ascended are Komagatake, Esan, and Usu. Many of the others I have only seen from a distance, in fact, rising as they do from the midst of forests, they are inaccessible to ordinary travellers, and it is doubtful whether many of them have ever been ascended even by the aboriginal Ainos. If we had a history of the Yezo volcanoes it is probable that we should find that they had exhibited an activity equal to that which is recorded of the main island. When travelling on the southern roads of Yezo you continually meet with materials testifying to such activity. As an example of the occurrence of these materials, I give the following extract from my note-book referring to the road between Hakodate and Sapporo. About 1 *ri* past Porobets the road



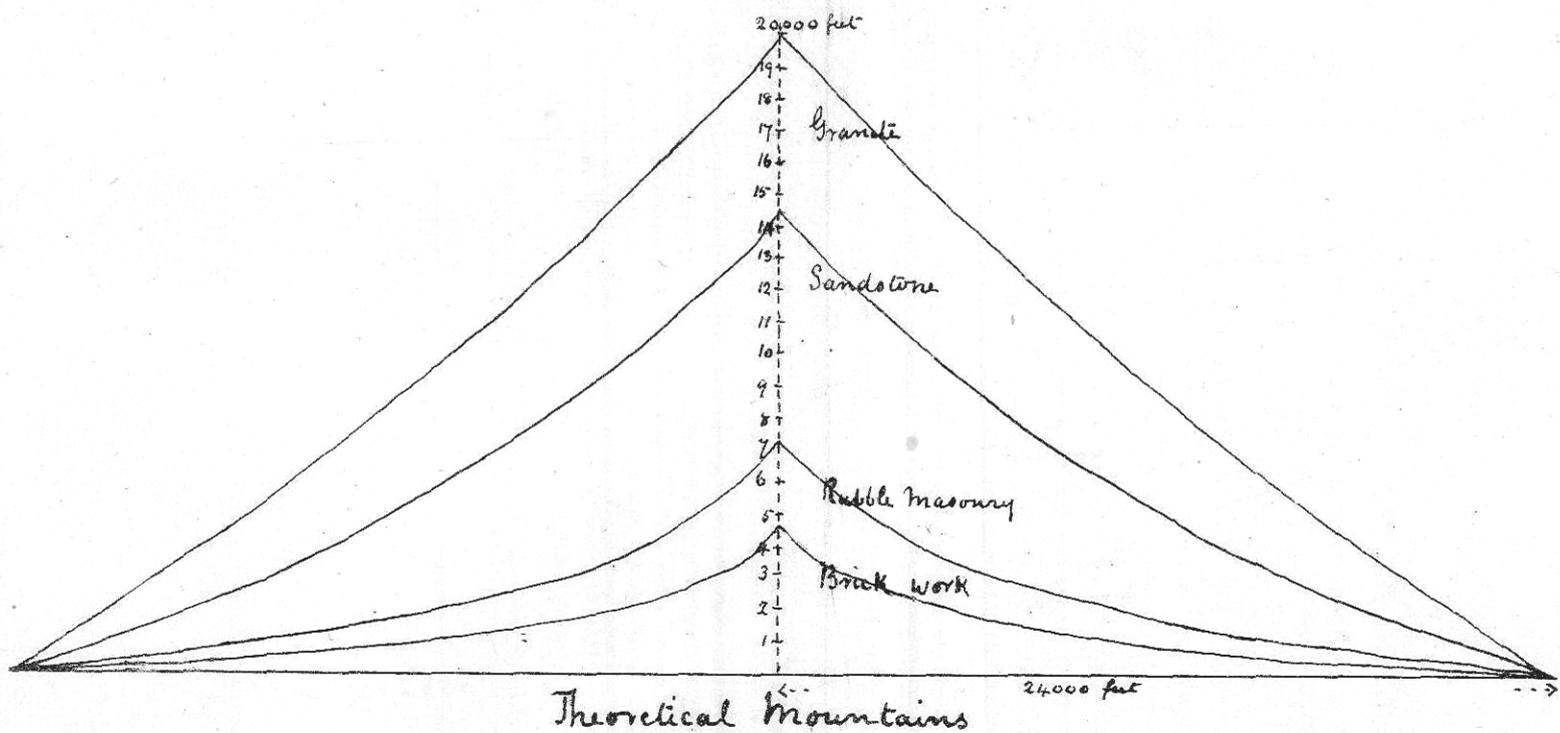
Profile of Volcanos traced from Photographs.

Plate 3

J. Milne del.



Profiles of Fujisan from Photographs and Surveys.



ascends by a cutting to the top of a ridge. The sides of the cutting show alternate layers of ashes and turf. At the bottom there is a thick bed of ashes, indicating a violent and prolonged eruption of some volcano. Above this, a bed of turf indicates a period of many years repose. This is succeeded by a second bed of ashes not quite so thick as the first. Following this there is more turf and a bed of ashes only about 6in. in thickness indicating a feeble eruption, and finally a surface layer of vegetable mold.

KUMAGA-TAKE (*Plates 7 and 8*).

I ascended Kumaga-take in 1877. The first part of the ascent from the Hakodate side is made on horse back passing through thick woods. The latter part of the ascent, which is made on foot, is up over a steep slope of scoria and pumice. Looking down you see three lakes which have apparently been formed by an eruption of Kumaga-take, blocking up a water course. That this occurred in recent times is testified by the fact that in the lakes you find many stumps of trees standing in the position in which they grew. The height of the lowest lip of the crater is about 2,600 feet. On the west side of the mountain there is a rocky pinnacle which, so far as I am aware, has only been ascended by Mr. N. Fukushi, when working in connection with the Trigonometrical Survey of Yezo. The total height of the mountain is about 3,200 feet. On the north side, Komaga-take shows the logarithmic curvature characteristic of volcanic mountains.

Mr. Fukushi tells me that there was an eruption on June 27th, 1710, and again on September 26th, 1856.

Captain Bridgford, R.M.A. (Trans: Asiatic Society of Japan, Vol. II., p. 89) gives the height of the first crater as 2,800 feet, the rocky peaks rising about 500 feet higher. Within the large crater, he says, there are 6 smaller craters, one of which was in activity two years ago (1872). This latter is 120 feet deep. The others are about 100 feet in depth.

On *Plate 7* two outlines of Komaga-take, taken from photographs are given. There is a sketch of the peak and a view of the mountain from Volcano Bay on *Plate 8*.

The following refers to a plan of the summit of Kumaga-take (*Plate 7*).

1. Large crater.
2. Rocky ridges nearly at right angles.
3. A pit crater, say 250' × 260' and 60' deep. The slope down to this is steep, and there are fissures running to the pit crater. In the pit crater there is burning sulphur and steam.
- 4.4. Gorges.

USU VOLCANO.

I ascended this mountain in 1878 and again in 1884. With the exception of the last few hundred feet you can ride through the woods up the mountain on horse-bark. On the top there is a large, well formed crater with three small ponds at the bottom, and two steep peaks rising from their edge. The greatest diameter of this crater is nearly half a mile. The crater slightly steams on its eastern rim. Steam also escapes from the side of the larger of the two peaks. The highest point is about 2,000 feet.

Round the base of the mountain there are many hummock-shaped mounds (parasitic cones?), and the outlines of old lava streams now covered with vines and other undergrowth can be traced. The following refers to a plan of the Usu crater (*Plate 7*.)

1. Highest point, a peak of angular stones.
2. A red coloured peak.
3. A ridge.
4. 5. 6. Small ponds.

From the sides of the highest peak there is a small shoot of stones falling every three or four minutes. The steam from No. 1 is sometimes sufficient to hide it. There was not so much steam in 1884.

It appeared curious that the two peaks in the Usu crater should consist of angular stones, and not of cinders.

The stones on the top are compact and grey in colour (andesite?) On the outside slope of the mountain there is black scoria and a little pumice.

On the north side of the mountain, and lying between it and Shiribets-yama there is a large lake, which may have been formed by the damming up of a valley consequent on the eruption of Usu. Sketches of Usu are given in *Plate 7 and 8*.

ESAN.

Esan is a very rugged, irregularly formed hill. When I visited it, March, 1878, it was too foggy to see very much. The first ascent, approaching from Hakodate, was about 900 feet above sea level. Here there were one or two sulphur collectors engaged in boiling sulphur in iron pots. From here we turned up a very stony valley and went about 500 feet higher. The boulders and rocks over which we walked were either red, yellow, or white in colour, having been much altered by the escape of vapours. Here we saw a number of mud cones and dome shaped mounds. From the top of some of these steam escaped. One of them, about 30 feet in height, occasionally threw out lumps of mud. Several of these which had been cut into, showed that they were covers to well-like pits each of which contained a quantity of sulphurous mud which was boiling violently. The only evidences of true volcanic action were a few cinders which were embedded in the mud. For sketch see *Plate 7*.

TAROMAI OR TOMAKOMAI.

In 1878 Taromai volcano as seen from the road leading to Sapporo, appeared as an irregular group of hills, the one on the right being rounded, the middle one pointed, and the third slightly rugged. The one in the middle and the one

on the right were of a reddish colour and from between them a little smoke was rising. The slope towards the sea is gentle. Tarumai volcano erupted on February 8th, 1874, October 7th, 1883, and on January 4th, 1885. For sketch see *Plate 7*.

In company with a number of Ainos, I attempted to ascend Takakomai volcano, but was forced back by the weather and the thickness of the scrub.

The following refers to a section on *Plate 7*:—

1. Tomakomai Volcano with two craters.
2. A lake; but probably once a crater.
3. Enewa Volcano, about 3,000 feet above the lake, and probably 5,000 feet above the sea. Many jets of steam issue from this mountain.
4. Thick forest.
5. The sea.

The rocks are andesites. A little sulphur occurs here.

ENEWA (*see Plate 7*).

The above view of Enewa is taken from between Shitose and Shimamap. This mountain is slightly convex on the left side. The top is rugged and has a large crater. It is of a reddish brown colour. Between this mountain and the Tomakomai volcano there is a lake (*see section Plate 7*).

ODAKE AND MEDAKE (*see Plate 7*).

The above sketch represents the appearance of Odake and Medake as seen from the mouth of the Ishikare River, the distance in a straight line probably being 50 or 60 miles. No. 1 is Medake probably with a crater, and 2 is Odake with a characteristic volcanic curvature. Although these two mountains *look* like volcanoes, it is not known whether they will prove to be volcanoes on close examination.

KURILE ISLANDS.

I made my first trip to the Kuriles in 1878. The notes which were then collected appeared as a paper under the title of "A Cruise among the Volcanoes of the Kurile Islands," in the *Geological Magazine*, December 11th, Vol. VI. No. 8, p. 337. A supplement to these notes appeared in the same magazine in April, 1880.

Owing to a continuance of foggy weather, which I do not think would find its equal even in Newfoundland, the want of harbours, and the strong currents, although I was almost a month steaming amongst these islands, it was seldom that we could effect a landing. In consequence of this the bulk of the material embodied in the following notes was written from what I saw from the deck of our vessel. However, as I had good opportunities for seeing nearly every island in the group, and many of these from several points of view, the following notes may not be altogether without value. One advantage which was gained by viewing these islands from a distance was that I was thereby better able to judge of the number, and the general form of the mountains they contained, and to roughly make comparisons of their relative heights, than I could have done had I been actually on the islands themselves.

In a few cases I endeavoured to estimate the heights by means of sextant observations. I also made many measurements of the slopes of the mountains which I saw; but as these were made with a small hand clinometer from the deck of a rolling ship, these measurements must only be regarded as rough approximations.

I have spoken of several of these volcanos as conical, but it must be understood that this, in many cases, only indicates a general form, the true form of the slopes being approximately logarithmic.

In the majority of cases the mountains and different portions of these islands are without names, and I have therefore had to describe them by their positions.

We finished our journey northwards at the southern extremity of Kamschatka, which is terminated with high black snow-capped peaks, looking as cold, cheerless, and uninviting as the most dreary part of Iceland.

The Japanese name of the Kurile islands is Chishima, or the thousand islands. According to the charts there would, however, seem instead of one thousand islands in the group to be not more than thirty or forty. Of these, Iturup and Kunashiri, which are the most southern members of the group, and which form the first links of the chain which volcanic agencies have built up whilst attempting to join Japan with Asia, are the largest. The length of Iturup is 113 miles. Its breadth varies from 77 to 6 miles. Kunashiri is 62 miles long and has a breadth of from 17 to 5 miles. The general direction of the length of these islands is from N.E. to S.W. and parallel to the general direction of the Kuriles, of which they form a part, the islands of Japan, the peninsula of Kamschatka, and generally of the shores of the N.W. portion of the Pacific in which they are situated.

On the north, Iturup is divided from the island of Urup by the Vries Strait, which is about 17 miles broad, and on the S. from Kunashiri by the Pic Channel, which is 14 miles wide. The greatest depth in these channels is unknown, but from the soundings on the charts we may safely say that it is over 100 fathoms. To the S. of Kunashiri, and separating it from Yezo, we have the Yezo Straits. These at their narrowest parts are only 10 miles in width. In other parts they are 17 to 20 miles wide. Unlike all the straits which divide the Kurile Islands from each other, with the exception perhaps of the Little Kurile Strait separating Simushir from Paramushir and Srednoy Strait, this is very shallow, being filled with sand banks. These banks are the most observable between the south of Kunashiri and Shibets, and as a continuation of the sandy spit from the E. side of Tomari Bay. The banks appear to be the result of the accumulation of sandy materials resulting from the meeting of two currents; one coming south down the Yezo

straits on the W. side of Kunashiri, and the other down the E. side.

Not only do these currents by their meeting in a confined bay like that into which the S. end of Kunashiri projects, produce sand banks, but by variations in these currents the banks are in some instances more or less shifting and in consequence navigation becomes exceedingly dangerous.

During last summer I paid a second visit to the Kurile Islands, but on this occasion only travelling as far as Iturup. In order to make my previous observations a little more complete, I now add to what I have already given the notes which were then collected. With my own I incorporate a very large series of notes made by Mr. H. J. Snow, a gentleman who has spent several summers amongst these interesting volcanos, and also a few notes extracted from a memoir of M. Alex. Perrey entitled "Documents sur les Tremblements de terre et les Phénomènes Volcaniques dans l'archipel des Kouriles et du Kamtschatka" (Lu à la Société Imperiale d'Agriculture, &c., de Lyon, 17 Juillet, 1863).

SHUMUSHU OR PERVI ISLAND.

This is the most northern of the Kuriles. It is separated from Kamschatka by the Kurile Straits, which are about eight miles wide. Towards the south it is separated from Paramushir by the Little Kurile Strait, about two miles wide. As compared with the other islands in this group, Shumushi is extremely flat. Looking at it as we approached the northern entrance of the Little Kurile Strait, it presented an undulating surface. Where the convexity of these undulations came down to the shore, they terminated in low perpendicular cliffs. In other places which marked the low sweeping valleys, the land rose gently upwards and backwards as it receded inland. It was opposite to the entrance of one of these valleys, at a place called Myrup, where we anchored. Here there were three wooden houses which had been built by the Russians, and quite a number (perhaps a score) of half-underground dwell-

ings. On landing we found that all these were deserted, and in many cases even difficult to find, owing to the growth of wormwood and wild grasses.

The inhabitants of the island, who call themselves Kurilsky, are twenty-three in number. They chiefly live at a place called Seleno about four miles distant. In addition to their own language, they speak Russian very fluently, and also know something of the Aino language. For the last three or four years they have lived on fish, a few blae-berries, and the various animals they could shoot. I mention these people as they appear to be the only inhabitants in the Kuriles north of Iturup. By going up the bed of a small stream which flows down Myrup valley, and by travelling along the shore, I saw several exposures which showed beds of breccia overlying beds of volcanic rock. At a distance this breccia is generally of a whitish grey colour. Looking along the shore from Myrup northwards, you apparently see beds of grey breccia overlying beds of a black volcanic rock. On close inspection, however, the black rock is seen to be also a breccia, coarse in its lower portion, where it contains fragments of rocks, gradually becoming finer higher up, and finally merging into a grey tuff. The difference in colour seems to be greatly due to a difference in weathering and the action of the sea. Here and there standing up through this breccia are bands and masses of volcanic rock. One of the former of these, which has had the breccia worn away from its sides, stands up at right angles to the shore-line like a huge wall.

Its continuance towards Paramushir is marked by outliers which, by the action of the sea-waves, have gradually been cut off from it. At right angles to its length—that is, in a direction running from side to side—it is seen to have a columnar structure, which, whilst adding to its peculiar appearance, gives you some idea of the way in which it cooled.

Up the valleys masses of a similar rock are also to be found. Upon the sloping sides of these valleys the breccia (which was friable) is thick, but it is thinner near the tops of the hills.

As we entered the straits, to see headland facing headland was very noticeable. If we imagined the curves of the volcanic ridges from Paramushir to be continued eastwards across the straits, it was clearly evident that in many cases they would make an unbroken line.

When on Shumushu, by looking across the Straits at Paramushir, it was observable that in many cases the undulations, and more especially the bluffs, of the land on one side correspond with those upon the other. These observations suggested the idea that in times not far remote these two islands have been continuous. At the time when the high volcanos of Paramushir were in full activity, they probably gave forth the materials which form the breccia. At first these materials were large and coarse, but as the intensity of the eruptions gradually decreased, the ejectamenta became finer and finer, as is indicated in the deposit of tuff overlying the coarser stones. From the absence of any appearance of stratification, I should be inclined to think that this action was a continuous one; at first violent and fierce, and finally, after the beds in Shumushu had accumulated to a thickness of a hundred feet or more, weak and feeble, puffing out fine dust and ashes, which fell and formed the tuff.

This continuous action, of which we here have evidence, I may remark, is very different to the action which has been carried on by the volcanos further south in Yezo and Nippon, where we have stratified beds of varying thickness, showing that sometimes we had a violent eruption, and next a feeble one. Sometimes these rapidly succeeded each other, but at other times, as is indicated by an intermediate layer of soil, there were periods of repose. The outbursts of the Japanese volcanos have been spasmodic; whilst the outbreaks which covered Shumushu, which apparently came from the high volcanos of Paramushir, have probably been more regular in their action. When speaking of these volcanoes under the headings of the several islands in which they occur, I will give

other reasons for my belief that the building up of many of the Kurile mountains has been by a continuous action rather than by a series of spasmodic efforts.

Immediately after these eruptions we must imagine the Kurile Strait to have been bridged across by the lower part of a continuous volcanic curve. Subsequently, because the materials which formed this bridge were soft, the sea has gradually eaten itself a channel through it. This channel is not like the channels between the other islands, almost unfathomable, but shallow. The greatest depth being about thirteen fathoms. Whilst this was going on, subaerial actions have worn out the ridges on the volcanoes, and the slight hollows on Shimushu, which now form the valleys, shallowing the sea by the material derived from the land near their entrance.

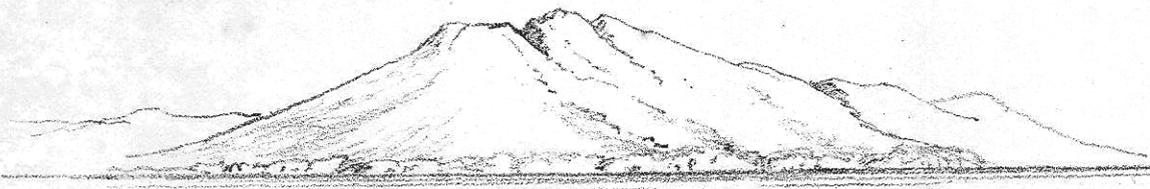
At the southern entrance to the Little Kurile Straits are a number of small islands called Torishima (Bird Islands.) These I did not see.

ALAIID ISLAND (*Plates 8 and 9*).

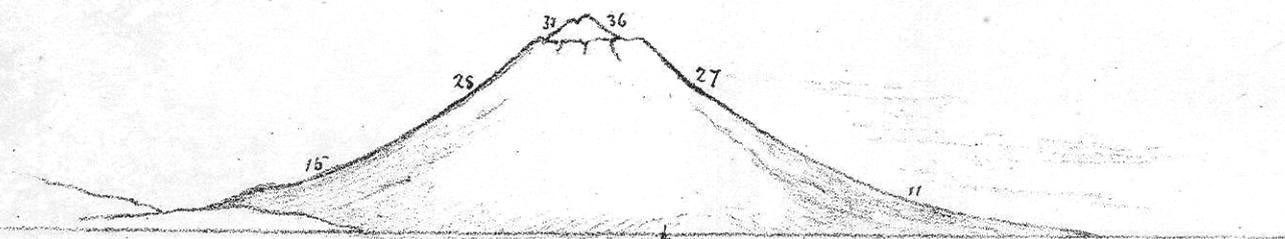
This is a small island lying almost eleven miles off the north-west coast of Paramushir. Its general appearance is that of a solitary cone. From a rough observation made at a distance of almost six miles this appears to be over 5,000 feet in height. When I first saw it, we were steering N.N.E. between it and Paramushir. At this place we sounded with forty-five fathoms of line without finding bottom. At that time the base of Alaid was covered with clouds, but above these the top showed itself like a huge wedge-shaped cap. The edge of the wedge, which apparently was the ruined rim of an old crater, formed the top ridge of the mountain. This ridge is on the W.S.W. side. As we continued on our course, the N.E. end of this ridge rose in a point, and was seen to be the highest portion of the island. Subsequently, when I again saw this mountain, I had an uninterrupted view from its summit to the base. On the S.W. side the slope near the top was 25° . Lower down this gradually decreased to 12° . From the



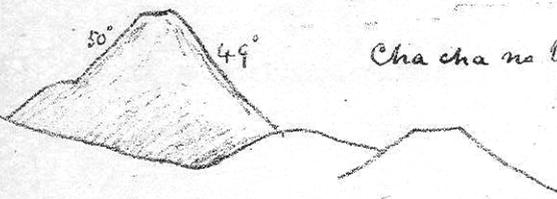
Mt. Fusa looking SW 6900 ft



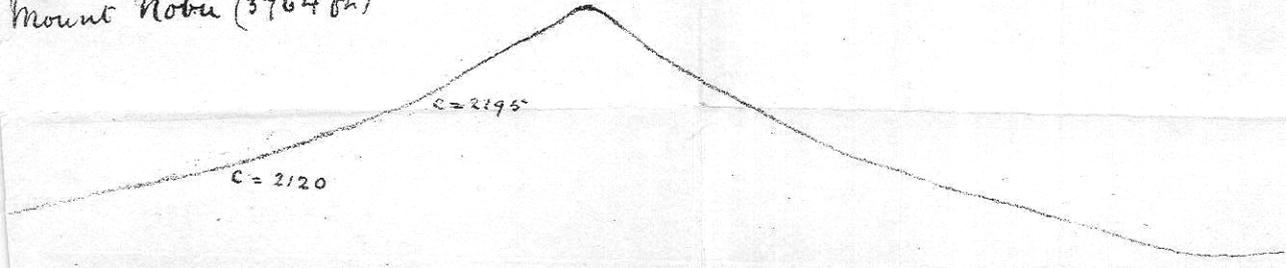
Rouse yama on Kunashiri



Cha cha no bori St Antons Peak 7400 ft.
Looking NE



Mount Nobu (3764 ft)



Alaid looking NE
Traced from a Photograph.

E.S.E. this side of the mountain was seen to have a slope of 30° , and an almost perfectly symmetrical appearance. The measurement of 25° had been taken along the edge of some degraded ridge which at the time of observation formed a profile of the mountain. On the N.E. side the slope at the top was almost 23° , and lower down 23° , and near the base 13° . From all points of view the mountain exhibited a distinct and beautiful curve. Looking at the surface, this was exhibited as a sweeping hollow. And if we except a few deep furrows which had been cut by rain and weather, its contour was perfectly regular.

Round the base of the mountain there was a growth of scrub.

In many places the shore-line was seen to be bounded by low cliffs. At the S.W. end these terminate in a small abrupt peak. These cliffs have in places a stratified appearance, a few thin earthy beds being intercalated with beds of ashes. From the way in which any one of these beds is seen to be continued along the shore-line, and also upwards along the scarp of the furrows, it would seem that the structure of the outer portions of this mountain must be that of a series of skins, or superimposed more or less conically formed envelopes. Although I looked carefully over the S.E., S., and S.W. slopes of this mountain, nowhere did I see anything which looked like or indicated the presence of a stream of lava.

From the structure exhibited by this mountain, the apparent absence of lava streams, and its beautiful form, the slopes of which, so far as the eye could judge, were of logarithmic curvature, this mountain, like many others in the Kuriles, of which I have yet to speak, was in all probability built up by a more or less continuous action, and consequently exhibited that elegant form which is natural to any heap of coherent materials. Since the last eruption, materials have been washed down from higher to lower levels, the top being made a little steeper, and the base more horizontal. Alterations near the summit, tending to increase the steepness, have probably taken

place more rapidly than at lower levels, from the fact that degrading agencies like rain would, for many reasons, be more active at high levels than at low ones. It is also possible that horizontality, and even a quaquaversal internal dip, may have been provoked, as Mr. Mallet has suggested, by the weight of the cone pressing down at the centre and raising up the rim. During these processes furrows were cut which hold perennial snows, and plants which fringe the base grew up from drifted seed.

Kracheninnikow says that, in fine weather, smoke can be seen issuing from this island :—

1770 smoke issued.

1793, in February, it was in violent eruption.

1802, on September 5th, it was covered with snow.

The height according to Landegrebe, by different estimations, is 14,717, 12,770, or 10,863 feet.

According to Mr. Snow, an approximate height by observation is 7,100 feet.

PARAMUSHIR ISLAND.

This island may be classed among some of the largest islands in the group. It is about 60 miles in length, as measured from N.E. to S.W.; its breadth is about 14 miles. From what I saw of it on the N.E., N., and N.W. shores, it appears to be altogether a mass of mountains. The S.E. point, however, is said to be long and low. On the N. and N.E. shore, facing the Little Kurile Straits, here and there, there are a few low cliffs; but for the most part the land slopes upwards from the sea to the summit of a line of irregularly-peaked mountains.

An irregular mountain, forming the northern end of this group, is giving off steam. It is covered with reddish scarps and patches of snow. This mountain is remarkable as being one of the flickering embers of those internal fiery forces which raised the Kuriles, and as it appears to be without name, either on the charts or amongst the inhabitants, I have ventured to name it Mount Ebeko. Three other high mountains may

be picked out of the irregular collection which is presented at the northern end of Paramushir. These are chiefly noticeable for their conical truncated forms and curvatures. From near the entrance to the Straits they respectively bear S.S.W., S.W. by W., and W. by S.W. The N.W. side of Paramushir shows a mass of irregular mountains. With the exception of a few red and yellow patches or scarps, apparently marking the effects of fire, everything looks black.

Rising above these are four remarkable mountains, which can be distinctly seen. Commencing from the north there is Mount Ebeko, which on this side presents the same irregular surface as it does when viewed from the Kurile Straits. It is easily to be recognized by the steam issuing from its summit.

- | | |
|---------------------------------|----------------------|
| No. 1. A sharp peak | 50° 25' N. Latitude. |
| No. 2. A well-defined cone..... | 50° 20' N. Latitude. |
| No. 3. Fuss Peak | 50° 15' N. Latitude. |

No. 1. From the views which I had of this mountain, it showed nothing more than a sharp peak which rose above the neighbouring mountains.

No. 2 and No. 3.—These two mountains are from their regular form to be ranked with Alaid, as being among some of the more remarkable peaks which build up the Kuriles. They appear to be the highest mountains in the island, and at the same time the most beautiful in shape. Approaching them in a south-westerly direction, they look like two slightly truncated cones.

No. 2, which from all points of view appears to be the highest, on its N.E. side looks as if it were joined on to some rugged hills, but from other points of view this appearance is seen to be illusory and the mountain to be almost isolated. On the side which faced us it showed a brownish red patch; with this exception, all the rest of its surface was black. On the N.E. side its inclination near the summit was 30°. On the opposite side it was 22°. On this side it sweeps down towards the plain with a decreasing inclination. Before it becomes

quite horizontal it rises to form the slope of No. 3 (Mount Fuss) *Plate 9*. The curving profiles of these two mountains have the appearance of a cycloid, but although I had not the means of determining their form, I conclude that, like all other volcanic slopes which I have measured, they must be approximately logarithmic. Whilst here I compared the slopes of these two mountains by bringing their profiles into contact by means of a sextant held horizontally, and so far as I was enabled to judge by the eye, they were in all respects similar. The two sides of Mount Fuss appear to be balanced in form, each having a slope of 28° . As we came closer, the profiles of these mountains, which had appeared to be perfectly regular, now showed a slightly ragged outline, no doubt due to the same cause which produced the furrows which could now be seen scoring their sides. Looking south, across the curve which joined these mountains, in among the mountains behind No. 2, a wall of rock was visible not unlike that of some ruined crater. From this point of view, the crater of Mount Fuss, which was slightly breached, was seen to be filled with snow.

As we sailed southwards, and looked back towards the N.N.E., No. 2 was seen first to the left of Mount Fuss, then towering above it, next immediately behind it, and finally to the right. From this point of view Fuss was seen to be very much truncated, and to have a very ragged and ruined crater-lip. Its sides, which were green, were suddenly terminated by reddish scarp-like cliffs, looking as if from time to time large masses from the face of the mountain had slipped seawards.

In addition to the mountains which I have mentioned, in the Admiralty Chart three large peaks are indicated on the S.E. coast.

On the whole, in Paramushir, if we except the isolated peaks, the mountains in the N.E. half are higher than those in the S.W. Apparently it is for this reason that there is so much more snow on the mountains at the northern end of the island than upon those in the southern half.

Anchored on the S.W. end for a few hours; many reefs and rocks here. The S.E. point is long and low with off-lying rocks and shallow water on the Pacific side to the distance of a mile and a half to two miles from shore. The observed height of Fuss Peak is approximately 6,900 feet (?)

On this island, which is regarded by Buch as being a continuation of the east coast of Kamschatka, "there are two peaks, —one in lat. $50^{\circ} 15'$ and the other lat. $50^{\circ} 40'$." According to Postels the first of them was in eruption in 1793. In 1737 and 1742 there were volcanic eruptions and strong earthquakes.

ASIRMINTAR, OR SHIRINKI ISLAND.

This is a small island which has apparently a flat top, lying about nine miles from the S.W. point of Paramushir.

An extinct volcano. The northern end of this island, according to Herman, is active.

Height, as observed by Snow, approximately 2,500 feet.

MAKANRUSHI ISLAND.

This island lies about 15 miles N.N.W. from Onekotan. When looked at from the east, it shows itself as a fine cone. On the N.W. side it has a dip of about 30° , and on the opposite side 28° . On the top three small points can be seen.

The lowest part of this island is on the southern side, off which there is a sandy bottom; the northern shore is bounded by high cliffs. Around the island there is much kelp. Observed height approximately 4,900 feet.—(*Snow.*)

In the centre of this island there is a volcano.

AVOS ISLAND.

This is merely a high perpendicular rock, estimated at 200 feet, with one or two smaller rocks lying close to. From a distance it has the appearance of a large ship under full sail. A short distance off thirty-five fathoms of water was found, the bottom being rocky and comparatively flat. It is the resort of thousands of sea-lions. On the admiralty charts it is laid down much too far to the southward.

ONEKOTAN ISLAND.

This island, which is about 24 miles long, and from 5 to 10 in breadth, lies about 20 miles S.W. from Paramushir. On the south it is separated from Kharim Kotan by the Shistoi Strait, which is about eight miles broad. On the chart it is shown as having six principal peaks, two of which are said to be dome-shaped. Looked at from near the north end, in a S.S.E. direction, three larger mountains can be distinctly seen, raising themselves above the rest.

No. 1, on the left, has a rounded top. At the base of this on the right there is a small volcanic cone.

No. 2, which is apparently the highest, terminates in a point.

No. 3 is a well-formed truncated cone. Further to the right in a S.S.W. direction the truncated cone on Kharim Kotan and Makanrushu can be seen.

One of these mountains had slopes of 30° and 29° .

Onekotan, as seen from a distance of about 13 miles, exhibits on the east side four large mountains, the two middle ones of which are well-formed volcanic cones.

About the middle of the island on the Pacific side, the coast forms a large sandy bay. Below this and around the S.W. end the land terminates in high, abrupt, black-looking cliffs with little or no beach; many rocks lie close under these cliffs, but there is deep water immediately outside. The coast to the N.E. of the sandy bay is somewhat low, gradually rising towards the N.E. end where it forms high perpendicular cliffs of a reddish colour. There appears to be no timber on the island. Observed height of highest peak near the south end approximately 4,400 feet.—(*Snow.*)

TO-ORUSSYR (ONEKOTAN).

According to Herman, there is an active volcano at the S. extremity of the island.

KHARIMKOTAN.

This lies eight miles to the S.W. of Onekotan. It is an island about seven miles in diameter. When looked at from the south, it exhibits a truncated cone.

A truncated cone rises from the middle of the island; its north eastern slope is covered with pumice. Some low scrub is found here, but no timber. There are a number of half underground dwellings on the W. side, but no natives have resided here for several years. On the Admiralty charts several reefs and rocks are marked which have no existence, this island being particularly free from off-lying rocks—the most so of any in the group. It is surrounded by an unbroken belt of kelp, to at least a half mile off shore. There is a depth of from 8 to 14 fathoms of water where the kelp grows. Observed height approximately 2,950 feet.—(*Snow*.)

At the centre of this island there is a mountain which was formerly active; at the foot of this on the east side there are two small lakes. There is a larger lake on the northern side. In the middle of the large one there are two rocks, and also a small one which appears to have burnt. Landgrebe and Herman speak of it as being active.

SHIASHKOTAN.

This lies about 20 miles farther to the S.E. It is about 12 miles long and three broad. Near the south end there is a well-formed truncated cone, and near the centre a similarly formed cone, which is still higher, and is yet active. Round the shores there are many low cliffs.

This shows a mass of mountains at each end gradually sloping and narrowing towards the middle of the island. There are two volcanoes here, one near the N.E. end, the other on the W. side of the S.W. end, both giving off large quantities of steam—the former in several places—with indications of much sulphur around both. In August, 1878, I visited the volcano at the N.E. end. From appearances, an eruption had not long previously taken place at its base on the western side,

close to the beach. Over a considerable area (perhaps two or three acres) there were many loose heaps of burnt looking earth and sulphur, from some of which smoke was issuing. In places the ground was soft and yielding, in others hard; with here and there springs and pools of water, some tasting of alum, others of sulphur and depositing a whitish sediment. The drift wood on the beach was all charred and the low brushwood in the vicinity partially burnt and killed. There is no timber on the island. The whole of the coast is rocky, with many reefs, but none extending more than about a couple of cables off shore. Observed heights of north end of Shiashtotan, approximately, 3,100 feet; of south end 2,750 feet.—(*Snow.*)

Pallas says that there are hot sulphur springs near the sea. He considers it (a mountain in this island) as having been formerly active. In the *Bulletin de la Société des Naturalistes de la Moscou*, 1858, there is a paper by M. Selsky on *Le Vulcan de l'île Chiackkotan*. This describes an eruption which took place in 1855. He also says that there are some hot springs on the shore. In 1854 and 1855 strong earthquakes were felt here. The volcano which is spoken of by M. Selsky (a Russian missionary) is probably Sinnarka.

EKARMA.

This island lies about 5 miles distant from Shiasht Kotan. On its N.W. side it stands up as a high irregular cone.

A volcanic cone on its S.W. side stands out from the main mountain. The slopes of this are covered with ashes and other loose material. The shore is bounded mostly by abrupt cliffs. Some low scrub and grass, &c., are seen on its E., N., and W. sides, but in the neighbourhood of the volcano there is little or no vegetation. No steam has been noticed issuing from this mountain during the last three years. Observed height approximately, 4,150 feet.—(*Snow.*)

Pallas says that on the shore there are hot springs, whilst flames sometimes issue from the mountain.

CHIRINKOTAN.

This island is about 24 miles distant from Shiash Kotan, on the same side as Ekarma. It shows two tall hills, which from their shape are probably of volcanic origin.

This is a double volcanic cone (an inner and an outer one). The outer cone is breached on the S.E. side. The inner one is giving off much steam, and streams of red hot lava flow down its sides, some of it finding its way into the sea through the breach and down a score in the side of the outer cone. This island is now the most active volcano in the whole group. The only vegetation to be seen, is on the N.W. point, where there are a few tufts of grass. Observed height approximately, 2,400 feet.—(*Snow.*)

Pallas says that this island is round, and 15 versts in diameter. It smokes continually and very often throws out stones.

MUSHIR ISLAND

Shows three small points or peaks. It consists of four small islets lying about ten miles from Shiashkotan.

This is nothing but a cluster of four rocky islets, almost bare of vegetation, and some smaller reefs and rocks between them. They are not one quarter the size marked on the Admiralty Charts and as there shewn they are considerably out of position. Estimated height in feet from 10 to 150 feet.—(*Snow.*)

MATAU ISLAND.

This island, which is about 7 miles long, lies about 50 miles S.W. from Shiashkotan. Near its S.W. side there is a lofty peak terminating in a sharp point. From the side of this peak steam can be seen issuing.

Steam is given off from the volcano on this island and occasionally a small stream of red hot lava may be seen trickling down its slope, noticeable more particularly at night. A hunter remained here during the winter of 1878-9. He says that he noticed lava streams at times, and on several occasions rumbling noises, accompanied by tremblings of the

earth. Off the east point, some half mile or thereabouts, is a small island about $2\frac{1}{2}$ cables in length, with from 8 to 10 fathoms of water between it and the main island; charts do not show this. Matau slopes to the S.E., the land on this side being low, with a sandy beach. A reef extends off the S. point. From N.E. round to S.W. *via* N., the land terminates in high cliffs with no beach. No timber is to be found. Observed height approximately, 5,150 feet.—(*Snow*.)

On the south coast there is a very high mountain, from the summit of which smoke is continually issuing. From time to time it throws out red hot stones (*Pallas*). This is the peak of Sarytschew. There is a crater on the west point of the mountain. Horner, as a mean of 11 observations, gives its height as 1,372 meters. From 10 miles to the N.E. the crater subtends an angle of $0^{\circ} 41' 4''$ which gives a diameter of 720 feet or 234 meters. On May 29th, 1805, Langsdorf saw another volcano, of which he does not give the position, which is probably Sarytschew on Matau.

RAIKOKE ISLAND.

This island lies about 5 miles N.N.E. from Matua. It has a flattish top, with one small peak.

This is a simple cone rising from the midst of the waters. It is very active. There were violent eruptions in 1778 and 1780.

Observed height approximately, 2,000 feet.—(*Snow*.)

RASHAU ISLAND.

Lies about 19 miles S.W. from Matua. This island, when looked at from a distance of about 12 miles, is seen to be made up of several hills, but none of them exhibited a form which could be identified with a modern volcanic cone.

There are many reefs and rocks off the E., S.E., and S. sides. High cliffs with very little beach, and deep water close in shore are characteristic of its N., N.W., and W. sides. Near the west point on the beach is a warm spring, the temperature of which is 111° Fah. The water has a slightly brackish taste;

does not discolour the rocks over which it flows. Some brush-wood grows here, but no timber. Between Rashau and Ushishir the sea is comparatively shallow (from 8 to 15 fathoms). Srednoy Island, as it is called on the chart, is a low flat rock forming part of a reef extending in a S.S.E. and N.N.W. direction about midway between Rashau and Ushishir. Besides this reef there are several other rocks appearing above water in the direction of Ushishir. The tide rushes through this strait at a great rate, causing very heavy and dangerous tide-rips. Immense patches of kelp grow around these rocks, which are the resort of thousands of sea lions. Sea otters are also numerous here, but there is seldom a chance to hunt them. Mr. Snow tells me that "on 12th July, when in this vicinity, we experienced what I believe was a submarine eruption. At the time of its occurrence we were about four miles to the westward of the Srednoy Rocks under sail, a light S.S.E. wind blowing, with thick fog. About 5 o'clock in the afternoon I was below lying in my bunk, when I heard a noise not unlike a line running out over the side of the vessel. I thought perhaps the lead was being hove. Again the same sound, but louder. Went on deck and asked if any one had heard any noise but no one had noticed it. Soon after this, the captain, hunters, and myself having just sat down to our evening meal, the same noise again occurred, resembling this time the sound made by a steamer blowing off steam, and causing the schooner to tremble perceptibly; the captain rushed on deck thinking we had run on some rocks. Hove the lead but could get no bottom. Up to 7 h. 30 m. p.m., at intervals of about fifteen minutes, this rushing noise could be heard, each time lasting several seconds. I tried the temperature of the sea and found it 36° Fah. (This is the usual temperature of the water around the Kuriles north of Iturup). The origin of the noise was evidently under the sea, the sound being communicated by the water. It could not be heard on deck. At one time I thought perhaps the sailors in the fore-castle were doing something to cause the noise, but on going to inquire found it was not so,

those below hearing the sound and thinking it thunder. Shortly after this we touched at Ushishir Island. I visited the crater to see if there were any signs of a recent eruption, but found nothing to lead me to suppose there had been a disturbance." Observed height of Rashau approximately, 3,000 feet; of Srednoy island, 25 to 60 feet.

USHISHIR.

Lies about 10 miles S.W. from Rashau. It is said to be made up of two islands, each about $1\frac{1}{2}$ miles long, connected by a reef two cables long. When viewed from the north, one of its ends is seen to be terminated by a high peak.

The southern island is the crater of a volcano breached on the S.W. side, giving access to the sea. The crater I should judge to be about a third of a mile in diameter. At the entrance there is only some three or four feet of water; inside it is deep, and there are two small islands. There is a sandy beach nearly all round the inside; the hills forming the sides are very steep and reach to a height of about seven or eight hundred feet, the tops forming a narrow ridge. From the N.E. round to the S.E. the hills are composed principally of pumice, from N. round to S.W. of hard rock. The highest peak is on the west side. Observed height approximately, 1,200 feet.

At the base of the hills on the E. side of the crater, and within 50 yards of the water, much steam is given off from a hot spring.

Over an area of some 30 or 40 yards square the ground is honeycombed, with here and there pools of boiling mud and water. There was a considerable deposit of sulphur here a short time before we left the island, but in September it suddenly disappeared and a large pool of boiling water, with heaps of stones around it, took its place.

There being no foxes here, myriads of birds make this island their breeding place. The most common are the tufted puffin (*mormon cirrhatum*), horned puffin (*mormon corniculatum*),

crested auks (*phaleris cristella* and *phaleris mystacea*), several kinds of gulls and guillemots, and wild geese.

On Ushishir there are at present fifty-six natives,* viz., thirteen men, sixteen women, and twenty-seven children. The last four or five years they have been living either on Matau, Rashau, or where they are now. They call themselves Kurilsky Ainos. They speak an Aino dialect, and Russian pretty fluently. Several of them also know a little English. Their dress consists of an upper garment made of bird skins (puffins) the feathers worn inside. In shape it resembles a shirt, on the back it is ornamented with the yellow plumes of the tufted puffin and its edges are trimmed with fur seal skin.

The men wear this garment tied in at the waist with a belt of sea lion hide. For lower garments they have to depend on what they can get from vessels that may call at the island; most of the men boast an old pair of trousers and one or two have a shirt. Moccasins made of sea lion skin cover their feet and legs to the knee. They live chiefly on birds, seals, and sea otters, the flesh of the latter being their favorite food. In the summer they get a few roots and berries.

At the centre of a bay at the south end there is a little island where we find hot springs and a quantity of sulphur. Buch regards this as a volcano. Pallas does not say that it has burned; he only says that there are some cracks 100 toises long (1 toise=6.39 ft.)

KETOY

Lies almost 30 miles to the S.W. from Rashua. It is mountainous, and its contour exhibits several rough peaks.

From the N.E. slope of the centremost peak on this island steam is issuing in several places. The land slopes to the

* These natives have since left Ushishir. After spending some time on Matau, Shiashkotan, Paramushir, and Shumshu, they were all brought down last summer (1884) by a Japanese steamer and located on Scotan. There are now no inhabitants on the Kuriles north of Iturup, excepting in summer, when a few Japanese fishermen may be found on Urup.

S.E., and there are reefs off the E.S.E. and S. points. The W. and N.W. coast is bounded by very high and steep cliffs. Some timber is to be seen here. Observed approximate height, 2,900 feet.—(*Snow*.)

SIMUSHIR.

This is separated from Ketoy by the Diane Straits, which are about 18 miles wide. It is 27 miles long and about 5 miles broad. On the chart it is drawn as exhibiting three peaks at its N.E. end. One large peak, known as Prevost's Peak, and four smaller ones, are to be seen near the centre, and another mountain at its S.W. end. The three peaks at the northern end are all conspicuous, and from their form they are evidently of volcanic origin. The central one is estimated as having an elevation of 2,100 feet. When approached from the north, this peak is seen to overlook Broughton Harbour. This harbour, from its plan and description, would appear to be an old crater, which has been breached by the sea. Its length is about three miles and its breadth one mile. Round the sides it has an average depth of 20 fathoms, and near the centre of 50 fathoms.

It is surrounded by steep hills. The entrance is by a channel about $\frac{2}{10}$ ths of a mile wide and with only a depth of from $1\frac{1}{2}$ to 2 fathoms. In consequence of this, it can only be entered by small boats.

The north-eastern coast of Shimushir, immediately outside the harbour, is bounded by steep hills which terminate in perpendicular cliffs.

The central mountain, known as Prevost's Peak, is very high, and in form is a well-shaped truncated cone.

On the north-west side of the peak, which rises at the southern end of the island, there is said to be a crater.

From the W. side of the mountains at the S.W. end of this island a volcanic cone projects; it is giving off a little steam. The slopes of this volcano are covered with a fine loose material, whitish in colour, coarser towards its base, around which

are strewn masses of black rock. The southern half of the island is almost bare of vegetation. At its N.E. end around Broughton Harbour there is some timber. Observed height of Prevost Peak, approximately 5,400 feet; south-west end estimated at about 3,000 feet.—(*Snow.*)

On Shimushir there is a mountain called Itarkioi which was formerly active. Perouse called it the Pic Prévost, modern writers call it the Pic Pérouse. It seems to have been extinguished for some time.

MAKANRURU OR BROUGHTON ISLAND.

This island is situated about 25 miles from the N.E. end of Urup. As seen from the S.E. it looks like a huge mound. At its N.E. end there are perpendicular cliffs, and at its S.W. end it slopes towards the sea.

Is surrounded by high cliffs, and deep water all round the island. Estimated height about 3,000 feet.—(*Snow.*)

BRAT CHIRNOI OR THE BROTHERS.

These two islands lie about 20 miles from the N.E. end of Urup. They each show a well-formed cone. When I saw them, the more northern was apparently giving off a little steam.

The northern island has two well formed truncated cones both giving off much steam in several places. The highest part is at the N. end, the mountain here has apparently been a volcano. There are signs of the crater having fallen away to seaward leaving very high and almost perpendicular cliffs. Immediately off this the depth of water is not more than from 8 to 10 fathoms for at least a half mile; elsewhere around the island the water is very deep close into the rocks. Projecting from the E. side of the northernmost mountain is the larger of the two volcanoes, the smaller one joining the S.E. slope of the larger. Near the base of the small cone much smoke finds its way through the heaps of loose, burnt looking rock which form this part of the island. When these mountains were in violent eruption in the summer of last year, the land at

this spot was raised considerably by the gradual upheaval of the rocks, large masses of which, becoming disengaged from the rest rolled into the sea. I was present at the time of this eruption, but not when it was most violent. Occasionally small streams of lava trickle down the sides of these volcanoes, difficult to distinguish in the daytime, but becoming very conspicuous at night, giving the mountain the appearance of being covered with lanterns. From a distance, the large irregular masses of black sulphurous rocks strewn over the lower part of the island have the appearance of trees, but there is no vegetation, except a little coarse grass on the N.E. point. A few small streams of water tasting strongly of alum find their way into the sea through the rocks.

The southern island is probably an old volcano long extinct; there is a crater-like hollow on its S. side about half way up the mountain. This island is covered with grass, but there are no trees or scrub. In the straits between the two islands and lying close to the southern one, is a small islet with a reef off it, narrowing the channel to about half a mile. Estimated height of north island approximately about 2,500 feet, of south island 1,800 feet.—(*Snow*.)

Tschirpooi (Brat Chirnoi) are two islands, each having a volcano. The first, according to Krusenstern, appears to be extinguished, but the other is active. This latter is conical and steeply scarped. Pallas says that it has thrown out stones all over the island. The neighbouring island is terminated by a comb-like ridge.

URUP ISLAND.

This is separated from Shimushir by the Boussole Channel, 56 miles broad, and towards the south from Iturup by Vries Strait, which is about 13 miles wide. The island is about 58 miles long and 15 miles broad. On the chart it is drawn as showing along its length 11 mountains. Looked at from the N.W. it shows a mass of mountains, many of which terminate along the coast in formidable cliffs. Amongst them

there appear to be three which might be reckoned as volcanic cones. From one of these, which was bare and red, steam was issuing. Towards the south the land, although steep, is much lower; but at the southern extremity it runs up to form a terminal mass of irregular hills.

Along the S.E. coast from the middle of the island four volcanic cones could be counted. The central one of these, known as Atatsu-Nobori (Mount Nobu) *Plate 9*, is remarkable for its steepness, on one side having a slope of 50° and on the other of 49° . This is the steepest volcanic cone I have yet seen. The probability is that it is either solid or else it is formed of very fine materials. On this eastern side of the island there is a small harbour. To the south of this there are two peaks known respectively as Pai-wa-nobori and Kaira-nobori.

At its N.E. end the land runs out easterly in a long narrow point, flat on top and some 70 or 80 feet above the sea level; through this the sea has made several breaches. From the N.E. end down towards the middle of the island on the Pacific side the water is comparatively shoal to a distance of two miles or more off shore. Urup is covered with a rank vegetation and there is plenty of wood, but none of large size. The coast is very rocky and there are numerous off-lying rocks and islets not laid down in the charts. Off the ends of this island the current runs very strongly, at times causing heavy tide-rips. Ranges and peaks on this island probably reach a maximum elevation of 3,800 feet.

ITURUP.

This is separated from Kunashiri by the Pico or Catherine Channel, which is about 15 miles wide. This island, which is the largest in the Kurile group, is 135 miles long and about 25 miles broad. It contains several large blocks of mountains separated by intervening spaces of lower ground.

Commencing at the N.E. and going towards the S.W., I saw the following mountains, which I think might be classed as volcanic peaks :—

1. Atsusa-nobori and Moshisi-yama, together with others, form a rough black group at the N.E. end of the island. From this latter mountain, which, when looked at from the south, shows a conical form, much steam is being given off.

2 and 3. These mountains form two sharp peaks which lie in juxtaposition.

4, 5, and 6 form the next irregular group of mountains. No. 4 is a truncated cone, No. 5 an irregular-shaped mountain (Rebunshiri-no-bori), from which steam is being given off. No. 6 is a rough-looking, stony mountain with a dome-shaped top.

No. 7 is an irregular dome-shaped mountain, slightly truncated (Atsusa-no-bori). When looked at in a westerly direction, it is seen to be a solitary double cone.

No. 8 is a truncated cone (Moshiri-no-bori). On the S.E. coast of Iturup there are many bold cliffs surmounted by wooded slopes. On Iturup there is one small harbour on the S.E. coast. And on the N.W. several small settlements. Near Cape Ikabanots there are also two peaks, the most northern of which is called Chiritsubo-no-bori.

The notes that I made about Iturup in 1878 were as follows:—

The first sight which I had of Iturup this year was on the 31st August, at 5 A.M., whilst steering through the Pico Channel making our way for the west coast. There I had a full view of the mountains which form the S.W. extremity of the island. These, which in the Aino language are collectively known as Berrytarabe-no-bori, form a high and formidable looking group. To the south and to the north they sweep downward in a graceful curve, on the former side towards a low cliff and the sea, and in the latter direction towards level ground. In between these symmetrical boundaries, however, there are a number of serrated high peaks and rounded hummocks. From near the centre of this group, close to which there is a bare reddish patch of earthy materials, smoke is said to issue. Although perhaps owing to the haziness of the morning I did not see the steam, the stony aspect and general contortions of

the ground are sufficient to justify us in regarding them as being of recent volcanic origin.

Leaving this and going northwards, we see the low ground which has just been mentioned rising to form a line of comparatively low hills faced with cliffs. Still further north, these cliffs have been cut suddenly back to form a deep semi-circular bay. The sides of this appear to be everywhere perpendicular. At the centre of the entrance to the bay there is a huge green-capped rock conspicuous from its size and its position. When looking at it from the S. and E. this rock bears a remarkable resemblance to a crouching lion. In consequence of this it is known to European navigators as the Lion Rock. The Japanese name is Moikisi. Looking past this rock into the hollow of the bay, it would seem that the perpendicular cliffs were made up of beds of a material arranged in horizontal layers. At the entrances to this bay, however, it is seen that these beds have an outward dip indicating that there was a quaquaversal arrangement in the strata. From the stony, lava-like character of these cliffs, taken in conjunction with the peculiar arrangement of the beds and the shape of the bay, it would seem to be probable that this bay is the remnant of an old crater, the Lion Rock being a fragment which remains upon its western side, from the ruins of which it rises. The size of this crater would be, as given in the chart, from $1\frac{1}{2}$ to 2 miles in diameter. Behind this bay towards the S.E. there are many hills. One of these, called Rokunobori, forms a remarkable peak with steep sloping sides—these slopes being on the visible portions as much as 25° . From this position it seemed to be a formidable mountain, but when we were further north, although it retained its peculiar appearance, its size was seen to have been over-estimated. Proceeding northwards, we crossed the entrance to Urbish Bay, in the bottom of which is situated the fishing station of Naito. At this point of our course we had before us two peaks which may be reckoned amongst the most remarkable of those of Iturup.

We approached these mountains from the S.W. The

one upon the outside or N.E. which slopes down to the sea is called Atosho or Araisayama. (*Plate 8.*) Its height is given on the chart as 4,050 feet. In shape it is a slightly truncated cone. The slope on the left side I measured as being 30° , whilst that on the right was 26° . The lower portion of this mountain, on its left hand side, is either hidden beneath the sea, down to which it slopes, or else has been cut off by the incessant action of the waters at its base. The companion mountain of Atosho-yama, which is situated further inland upon the right, is called Stokap-Karuoshi-Nobori. The steepest inclination on this mountain is about 25° . Its lower points, however, have the usual curvature common to so many volcanoes, the inclination getting less and less until it sweeps down gradually into the plain from which it rises. The truncation at the top of this mountain, the extent of which roughly indicates the diameter of the crater, is somewhat more serrated in its central part and at the same time larger than that of Atosho-yama. It may be remarked that both these mountains possess a slight break in the regularity of their slopes upon the right hand side indicating perhaps the fragment of the rim of a crater older than that which now exists upon their summits. As we came closer to Atosho-yama it was evident that the sides facing the sea were too steep and stony to be climbed. Round its base low cliffs have been formed, above these come patches of green herbage and stony *débris*. Higher up, the mountain was bluish black with ashes, whilst at the top these were red and irregular like large clinkers. On this side it was seen that it was impossible to be climbed, and a stone if set rolling from the summit would probably have continued with accelerated speed until it reached the sea. As we rounded the cape which Atosho-yama forms, it gradually shut out Stokap-Karuishi-Nobori, its companion. During the progress of this eclipse we had an excellent opportunity of comparing the curvatures of the slopes of these two mountains and their similarity was very striking.

The top of Atosho-yama is very rugged and looks like piles

of gnarled clinkers. On the N. side the crater is slightly peaked at the top. After rounding Atosho-yama, Stokap-Karuish-Nobori came once more into full view when looking in an easterly direction. From this point of view its two sides are remarkable for their symmetry, the curve on one side being an exact reflection of the other. Beyond this mountain, trending to the N.E., there are numbers of hills whose scarps are steepest upon the S.E. side. Running out to form a cape at the extremity of this line, Chirrup-no-bori, the mountain which rises behind the settlement of Shanna, could be seen.

It may be here remarked that the mountains which I have just described are illustrative of a rule regarding the conformation of the land which in Iturup seems to be very general; namely, that all the conspicuous peaks or groups of mountains form headlands like the boundaries of Shanna Bay or else the nucleus of the broader portions of the island; the narrower portions being usually low and flat. This appears to be so remarkable that it is suggestive of the idea that Iturup may originally have been composed of several island volcanic peaks which have subsequently been united by the elevation of the sea bottom from which they rose. Certainly it would seem that by a small subsidence Iturup might be resolved into a number of peaked islands like those which I suggest may perhaps have been its original nucleus. From Atsho-yama we steered N.E. for Furubets.

Furubets, which is a collection of five or six houses and a number of "godowns" or store-houses, may be regarded as the capital of Iturup. It is here that every vessel visiting this island for trading purposes has to call in order to interview the governor and obtain from him the necessary permits. The most remarkable point to be observed here is the terrace-like formation of the coast. This is characteristic of the shores of the bay in which Furubets is situated, and also of many other points round the shores of this island. These terraces form two slopes. The lower slope has a face of cliffs or cliff-like scarps, as measured by an aneroid, about 130 feet in height.

At this elevation you have a level plain running along the coast $\frac{1}{2}$ or 1 mile in breadth. From this plain a steep slope perhaps 200 to 300 feet higher brings you up to a second plain which forms the surface of this portion of the island from which the mountains spring. The edges of these two terraces form two lines parallel with each other and with the level of the water down below them. Coast terraces similar to them are characteristic of some portions of the other Kurile Islands and of Yezo in the south. At Furubets it is very noticeable that the base of the upper terrace is not so cliff-like as the lower one. As the upper terrace is evidently the older of the two, and has therefore been longer exposed to the action of denudation, it should be more worn away than the lower one, is a result naturally to be expected. The materials of which the lower terrace is formed are boulders of various dimensions from 2 or 3 feet in diameter down to a few inches, mixed with ash and other volcanic ejectamenta, all of which have been cemented together to form a hard volcanic agglomerate. Here and there, standing out though these agglomerates are cliff-like masses of a hard, dark grey porphyritic trachyte. In places this is somewhat decomposed. Where these appear, small capes or points are formed, whilst between them the softer materials have been cut back to form shallow bays. It is in one of these shallow bays in the entrance of a gulley running back inland, which has been worn out by a stream through these rocks, that Furubets is situated. Having obtained our *menjo*, or permit, from the governor at Furubets, we sailed northwards round a remarkably flat tableland-like looking point to Rubets. Here there are a few straw-roofed huts on a flat shore near to the entrance of a river. The ground of the first terrace which is to be seen here appears in places to be roughly stratified, the strata dipping towards the N. Back inland, however, there is a conspicuous group of peaked mountains which forms the high ground on the eastern side of Shitokap Bay (Jap. Bay of the Foreigners) on the S.E. side of Iturup.

Taking these mountains seriatim, commencing on the left

or N.E. and going to the right or S.W., their appearance is as follows :—First there is a regular cone, truncated at the top and evidently a volcano of recent origin. This is probably the highest mountain in the group. Next to this comes a bare rugged piece of high ground of a whitish colour, from which at one time it seemed as if steam was issuing. From the extremity of this there is a serrated, rocky-looking peak, which is immediately succeeded by an irregular-topped conical mountain, the central and most massive looking and also the largest mountain of the group. From near the top of this mountain on its left hand side a heavy jet of steam is visible. This last mountain, its neighbour on the left, and the regular cone first mentioned, seem from their appearance to have been very recently active. From here towards the right there are several peaked green covered hills becoming lower and lower until near the extremity of the range, where a sharp, somewhat pyramidal looking point rises up like the cone of an old volcano. This protrudes above the sides and before the breached entrance to an old crater. The rocks on the shore line near here are volcanic breccias containing large angular boulders. The river which enters the sea at Rubets is deep and with few rapids. It was very noticeable that about four miles up, all the stones in the bed of the stream were subangular and not rounded. After leaving Rubets we steamed northwards round the high peninsula formed by the group of mountains known as Chiritsuna or Chirrup-na-nobori. The highest peak of these is marked on the chart as being 5,040 feet above sea level. As we rounded this point, and when looking at it on its eastern side, we had before us a mountain not altogether unlike Atosho-yama already described. The sides of this mountain, however, are much more furrowed and the top more rounded, indicating that it is some time since it last erupted. On the top the mountain appears to be very stony, but lower down it is covered with trees and scrub. In places patches of snow could be seen. At the base there are cliffs or steep scarp-like slopes. Beyond this first mountain there is a second

one with a rugged top. After sailing a short distance beyond this point in the direction of Bettobey and looking back towards the N.N.W., the second peak which I have mentioned seemed to be even larger than the first. On the top it was reddish coloured and very stony. From a point near the top of this mountain steam is said to issue. On the left hand side of the mountain a well marked profile having the usual curvature is observable. The slope on the top of this curve is about 29° . Near the base there is a slope of 15° . From this point the profile of the first mountain had near its summit a slope of about 30° . Looking right ahead towards the South a flat, rugged looking cone can be seen. To the right of this I again saw the rough group of mountains which form the eastern boundaries of Jap. Bay. At this point all the prominent peaks of this side of the island apparently terminate. Further towards the E.N.E. termination of the island all that is to be seen, although we sailed along the whole line of coast, is a rough ridge-like looking range of hills. The rocks upon the coast about Bettobey are coarse, black-coloured volcanic breccias. At one place I observed an old dark-coloured lava stream with prismatic joints. Parallel with the shore here there are two lines of sand hills apparently marking an old coast.

From the extremity of the Chritsuna-yama Point I had one of the inaccuracies of the charts of this part of the world pointed out to me by Captain H. J. Carrew, a gentleman to whom I am indebted for assistance in obtaining information about this part of the island. Taking a bearing from the chart from this point to Subetori, which is situated very near the N. extremity of the island, it was found to be N. 55° E. Actually, however, the bearing, after all corrections have been made, is N. 82° E. After taking bearings from various points and directions and carefully measuring distances, Captain Carrew finds that if we assume the southern portion of Iturup to be rightly placed, the northern end requires to be drawn almost wholly in what is now shown as a portion of the Pacific several thousands of

fathoms deep. Similar remarks may be made about the positions of the other islands which Captain Carrew has visited. On this portion of the coast the places which were visited were Bettobey, Sukeya, Makayomi, and Subetori. At each of these places there are from one to three or four Japanese houses, and a few store-houses. At Subetori there is in addition a small Aino village. The bulk of the population, scanty as it is, is a migratory one; the coolies who are to be seen at the various stations only being engaged during the fishing season. The fish which are caught are salmon and salmon trout. These exist in such numbers during the summer and autumn season that their fins sticking out of the water near the entrance to the rivers look like tangled masses of kelp; whilst up the rivers it is but little exaggeration to say that some of the pools are mixtures of fish and water. With a rifle bullet you may pierce four to five at a single shot. The shingle shoals are often covered with dead fish which in their struggle for existence have become so weak that having once run themselves ashore they are unable to return to deeper water. A single haul of a small seine upon the beach brought to land a huge heap of fish, varying in weight from four to twenty pounds, the number of which we roughly estimated at 5,000.

The shore line along this portion of the coast is generally sandy. From Subetori northwards, however, it appeared to be rough, there being many detached rocky islets visible, whilst the shore line itself was in places almost impassable from the number of boulders. This rocky appearance of the shore line is also characteristic of the south especially, as would naturally be expected, where there is a promontory.

About six miles above Bettobey the shore line seems to be faced with white scarps of high hill-like banks. These are probably banks of a pumiceous material. At Sukeya I saw the only rock which could claim to be of a true sedimentary origin. This is exposed in a series of high cliffs running round the bay in which Sukeya is situated. It is a greyish white sandstone or grit, the component particles of which are of volcanic

origin. The particles are too angular to have been long beneath the water subjected to any active degradation. In the bed of the river at Subetori I observed that the greater number of pebbles and boulders were dark grey andesite. Here and there a piece of hard bluish felsite and pieces of red jasper could be met with. A rugged point to the N. of Subetori was also andesite, and from its scoriated cindery appearance, I concluded that it formed portion of some ancient lava stream.

At all the fishing stations a stream or river is to be found. This on being traced upwards, as at Rouse, near Rubets, and Bettobey, terminates in a lake. Unless you follow up the bed of one of these streams or keep to the coast line, the density of the scrub or rather jungle, which chiefly consists of bamboo-grass, makes Iturup quite impassable. The only chance of reaching the mountains from which this barrier most effectually keeps you away, appeared to us to be along the bear tracks which are very numerous. In the beds of the rivers bear tracks are exceedingly numerous and very large. It is not unlikely, from all that I could gather, that the Iturup bear may be a species which is new to science. From the specimens seen in cages, it seems to resemble the grizzly bear of North America.

Previous to 1878 the volcano near the middle of the island was not noticed to be smoking, but steam was issuing from several places on the beach at its base. In the year above mentioned vapour ceased to be emitted from this spot and steam was then noticed coming from its summit. Farther to the N.E., under some white hills (pumice), are several hot springs on the beach close to the water's edge.

According to Bach, there is a volcano in the middle of the west coast. According to Pallas, there is one at the north end of the island. It continually throws out flames and smoke. It is not shown by Herman in his map as being active.

KUNASHIRI.

This island is separated from Yezo by a channel about 8 miles wide; it is about 65 miles long and 12 miles broad.

Near its northern end a conspicuous mountain rises up, which is known as Cha-cha-no-bori. This mountain shows two distinct cones, the upper one of these is sharp and pointed, and rises above the truncated summit of the lower one, which sweeps in a beautiful curve down to the plain beneath. This mountain is easily recognized by its superior height, standing up black and sharp above all that surrounds it. The crater, forming the summit of the lower cone out of which the upper cone springs, is said to be filled with water, forming a crater lake, from which the upper cone rises like an island. For this reason the summit of the mountain is said to be inaccessible. Near the base of this mountain, which yet gives off a little steam, and contains deposits of sulphur, there are many hot springs.

Further south there are Suisaikenobori, and Stara-na-bori, Lousoyama, and Shimanobori. Of these, Lousoyama, which, when viewed in an E.S.E. direction, shows a truncated cone, yields sulphur, and still gives off steam.

At the extreme S.W. is Tatshinouse-nabori, which when looked at in a N.E. direction, shows on its left side the volcanic curve. This end of the island is bounded by low greyish-white cliffs.

The island of Kunashiri, like that of Iturup, is one of the largest amongst the group which form the Kurile Islands. When seen from Nemuro, a small port in the north-east of Yezo, it appears like three distinct high-peaked islands situated at equal distances apart on a line running towards the N.E. The most northern of these, which is distant about 90 miles, bears N. 30° E. and is a peak of 7,400 feet in height. On the English charts this is marked as St. Anthony's peak. The Japanese and Ainos know it as Cha-cha-nobori. (*Plate 9.*) As the views which I had of it this year were altogether from an opposite direction from that in which I saw it before, and because it is one of the most remarkable peaks of the whole of the Kurile group, I will add a few more remarks to what has previously been said.

Looking at the mountain from Shishiki, a settlement about half way up the east coast of Kunashiri, it stands up like a huge, flat, slightly truncated cone, the sides of which have been slightly hollowed out into graceful sweeping curves. Above the truncation at the top a small peak projects. This is a second cone rising from the crater of the lower one. The story that I heard two years previously about the crater of the first cone being filled with water forming a lake, from the centre of which the second cone springs up, was confirmed by all the inhabitants with whom I spoke. When I looked at the mountain and saw a regularly shaped peak over 7,000 feet in height, built up of ashes, and was then told that on the top there was a huge reservoir, the statement seemed as incredible as it was interesting. The slope of the main cone on the left hand side varies from 28° near its summit to 15° near its base. On the right hand side the slope varied from 29° near the top to 11° , where it swept down into the plain. The small upper cone which indicates a second eruption has a slope on the left hand side of 37° , whilst on the right it is 36° . The steepness of this latter cone seemed to indicate that the materials of which it is formed were in all probability much finer than those of the large one. As an indication of the age of the larger cone, we might measure the depth of the furrows which, when looked at with a glass, are seen to score its sides. To the left hand of Cha-cha-nobori, some distance away, I could see a ragged, much broken, and stony looking cone which seemed from its colour and general aspect to have been active within a recent period. Nearer to Shishiki, in a south-west direction from this point, the eye passes over a comparatively low country, studded with small peaks and hills of various shapes, until you reach the mountain group which rises above Shishiki. This group, the highest peak of which is called Rouse-yama (*Plate 9*) forms the central mass of the group of mountains which rise in the centre of Kunashiri. From Nemuro this group bears N. 16° E., and has a height, according to the chart, of 3,020 feet. If we view the

mountain from the S., a few miles off from the coast, it is seen as a stony looking truncated cone rising from the centre of the block of mountains of which it forms the chief component. To the right and left of this the hills are green with forests of fir and grass.

At Shishiki, where there are one or two houses, there are some hot springs. The rocks are greenish black trachytic porphyries. From here I ascended the sides of Rouse-yama as far as a deposit of sulphur which is being worked. The road, which I imagine is the only road in the Kurile Islands, has been cut through a magnificent forest of tall, straight firs. It is about four or five miles long and winds round and at the same time up the hill. The only exposure of rock is at the sulphur deposits, and here what was apparently an andesite has been much altered by the vapours which are issuing from the ground at many points. These beds of sulphur are situated on the sloping ground near the head of a steep scarp'd valley. As you near the place you perceive a smell of acid vapours and sulphuretted hydrogen. These vapours have, as might naturally be expected, destroyed much of the vegetation in the vicinity. From the number of dead trees lying *in situ* it would seem that this solfatara, or at least certain portions of it, had not long been in existence, the trees having been killed subsequently to its appearance. The sulphur exists in patches, in irregular heaps, and disseminated through beds of earth and clay and also through the rocks. Some of it seems to have been deposited from the vapours on the surface, whilst other parts from their appearance look as if they had been deposited under ground in the interstices of a decomposing rock. The area which is covered with the deposit of sulphur and fumeroles will probably be several acres in extent. The thickness of the deposit will in different parts be very variable, in places only a few inches, in others several feet. To the south-west of Shishiki we come to the third and last of the mountain blocks which build up Kunashiri. The height of this, as given in the charts, is 1,800

feet. From Nemoro the central peak of this mountain bears N. 2° W. From this peak the ground slopes downwards with an irregular outline to the right and left. When looked at from a distance it is remarkable as being altogether of a brown colour, whilst all the other mountains appeared quite black. This colour is due, I believe, to the fading of the bamboo grass with which it is covered, the other mountains being all more or less covered with trees. At the southern extremity of Kunashiri beneath the slopes of this mountain, the small settlement of Tomari is situated. Round the bay at this place there are whitish cliffs which from a distance look as if they were pumiceous or else whitish sands. Round the eastern shores of Kunashiri there are in many places green bank-like cliffs about 100 feet in height. What I have here said about Kunashiri and Iturup refers chiefly to the east coast of the former of these islands and to the west coast of the latter.

The general aspect of the surface of this island is unlike the rest of the Kuriles. The coarse, rank vegetation seen on Iturup and Urup is not found here to any extent, the hills being covered with a short kind of bamboo-grass, with groves of timber and isolated trees giving it a park-like appearance in many places.

SCOTAN.

This island lies about 40 miles from the S.E. coast of Kunashiri. It is nearly circular in form, having a diameter of about 5 miles. At a distance, when looking in a southerly direction, it appears to be rugged, and not to have any distinct peak, although the "China Pilot" says that from the centre there is a mountain which is even and uniform to its summit.

From Shishiki and other places in the neighbourhood I had several views of the island of Scotan lying to the eastward. So far as I could see, it seemed to consist of a number of rugged peaks and the even, uniform mountain raising from its centre, spoken of in the *China Pilot*, could not be seen. The island is chiefly remarkable for its two crater-like harbours.

The coast of this island is indented with many small bays, several of which form landlocked harbours. They are hardly suitable for very large craft. The highest portion of the island is on its northern side, a roundish-topped hill rising to the height of about a thousand feet. The land is very rugged, the whole island being a mass of irregular hills and valleys running in every direction. Shikotan is not thickly wooded, though there is no want of timber of good size. The trees grow principally on the spurs of the hills. There is very little scrub; on the high ground a short kind of bamboo-grass is found and in the valleys a long coarse grass.

ITASHIBAI ROCK, PARAKU ISLAND, SHIBRTON ISLAND, MUSHIRIKA ISLAND, HAMKARU KOTAN ISLAND, AKIRŌ ISLAND, SISIO ISLAND, MOYURURE ISLAND.

These are flat rock-bound islets lying to the S.W. of Skotan, and between it and Yezo. Looked at from a distance, they appear like a broad black line drawn upon the horizon. From the out-liers which they throw off towards each other, and also towards the adjacent mainland, which in all respects resembles them (being flat, and with a slope of 20 or 30 feet down to the shore), it is probable that not only were these islands at one time continuous amongst themselves, but were also at the same time united to the N.E. end of Yezo.

NEIGHBOURING MAINLAND.

At Nemoro we see the junction between the old volcanic rocks and the Horumui group (tertiary brown coal measures). These latter, as seen at Nemoro, consist of somewhat friable, thinly bedded clay shales, and the former of dark coloured andesites. The andesites form the islands and projecting rocks along the coast, while the shales are cut back to form the bay. A short distance back from the line there is a bank-like range of cliffs about 30 or 40 feet in height. The top of this is practically the level of the surrounding country, which but for the small valleys cut out by the streams, would be one flat plain, which it appears to be when seen from a distance.

Although the immediate surroundings of Nemoro are flat, in the distance many high peaks are visible. Commencing from the west and going northwards, we have the following :— Bearing N. 85° W. there is a high, well-shaped truncated cone, the right side of which is overlapped by a block of irregularly shaped hills. Next to this comes a low cone bearing N. 83° W., a short distance further on this is succeeded by a solitary high truncated cone. The truncation of this latter slopes slightly upwards towards the right. The bearing of this is N. 80° W. The three mountains just mentioned stand up from the horizon like islands from the sea. The first and last of them are apparently the peaks of the mountains Meakan and Oakan. Beyond this point we come to land which is more continuous. First the ground is low and irregular in outline until it rises to form a roughly truncated cone, the upper edge of which is serrated. This bears N. 74° W. Continuing northwards there is a long line of gradually rising land which at one place seems to be broken by the irregular lips of an old crater. The further northwards you look, the more irregular does the outline of the land become, there being many cones and peaks. On a line N. 54° W. there is a tolerably well formed cone to be seen; the fifth peak further to the north is also conical and truncated, and is also possibly a recent volcano. Beyond this the ground again rises, the highest point being in a direction N. 80° W. The latter mountains are those which form the peninsula of Cape Sirotoko, the view of which is overtopped by the S. extremity of Kunashiri. In this peninsula several of the mountains are said to be of volcanic origin. At Shari they yield sulphur.

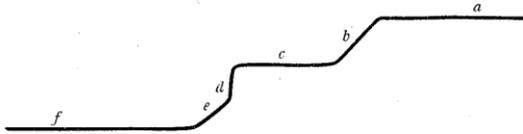
CONCLUSION.

The two islands, Iturup and Kunashiri, about which I have last written, form the first of the series of stepping stones which connect Japan by means of Kamschatka with the remainder of Asia. If we look at the general appearance of these connecting links it would seem that these two islands are the older

members of the group. Both Iturup and Kunashiri appear to contain a greater proportion of rounded hills and of deeply cut valleys than any of the islands further north, and, as the production of these appearances takes a considerable period, we may be safe in regarding the islands in which they occur as being older than those islands which are built up almost entirely of finely formed volcanic cones. The only other island which presents appearances at all like those of Iturup and Kunashiri, so far as I have seen, is their neighbour Urup.

As a further indication of the superior age of these two islands, we may take the patch of stratified rocks I have mentioned, which seem to indicate that since the materials which were shot into the sea whilst the nuclei of the island were being built, a slight elevation has been in progress, while although materials were undoubtedly deposited in the sea from the neighbouring islands, they were not deposited in time to be lifted by the elevation which raised up the fragmentary beds in Iturup. Just as we can, by the general physical appearance of Iturup and Kunashiri, say that they are probably older than many of the islands further to the N., so we can determine the relative ages of different parts of one and the same island. Thus, from the generally worn and overgrown appearance of the S.W. end of Kunashiri, as contrasted with the rugged and gracefully shaped modern volcanoes of its N.E. end, we can say that the S.W. end of this island is older than the N.E. end. It is of course possible for us to imagine that the two ends of such an island were lifted or built up simultaneously, and the present difference in general appearance is only due to the volcanic forces having continued for a longer time in action at one end. The general appearance of the mountains, however, is against such a supposition. When looking at an island like Iturup, I should be inclined to think that its formation commenced as a number of volcanic peaks forming islands, and that these have been subsequently united by elevation, indications of which elevation we have in the stratified rocks and terrace formations. At

Furebets a section drawn at right angles to the coast would be very similar to the adjoining figure :—



a is the highest level ground from 400 to 500 feet above sea level. *b* a steep slope about 300 feet high, which was probably once a cliff leading down to the terrace *c* 130 feet above sea level. *d* a cliff or extremely steep scarp leading down to the upper end of a beach *e* which slopes down to the sea level *f*. From an inspection of such a coast line it would seem probable that *a* had been a plain once beneath the sea. This was then elevated about 300 feet above sea level. After this it was cut back to form the cliff *b* and the plain of the terrace *c*. Elevation then continued for another 130 feet. After which marine denudation cut back the plain *d* and subærial denudation gave a slope to the face of *b*.

Since this a slight elevation may have been going on to raise up the beach *e*; this lifted the cliff *d* beyond the marine action upon the present sea board. At Hishiki on Kunashiri, and at Nemoro on the mainland, the section at right angles to the coast line would be represented by the portions *c*, *d*, *e*, *f* of the above sketch. In Kunashiri the height of *d* would be about 130 feet, whilst at Nemoro only 30 or 40 feet. Assuming that the upper portions of these terraces were identical, which from the extent of ground they cover and their respective situations does not seem to be improbable, then we see that the elevation of a given plain has in Kunashiri towards the north been greater than near Nemoro towards the south. The elevation has in fact been greatest near to the volcanoes, diminishing as we recede from them.

I may here remark that all the appearances which I have here ascribed to a raising of the land might equally well be explained by a raising and lowering of the sea—such, for in-

stance, as that which Mr. Croll points out as possibly due to the accumulation of ice during a glacial period at the pole; as the height of these terraces increase as we go northwards they would appear to confirm such view. In sailing along the face of cliffs like these, it is interesting to note the river valleys which are cut through them. Where the valley is small the stream which fills it reaches the upper edge of the cliffs and then drops suddenly to the sea level as a water fall. In other cases where the river valley is large the stream reaches the sea level gradually. In the one case where the stream is small its rate of cutting downwards has not been so rapid as the action of the sea in cutting backwards. Where, however, the stream is large the rate at which it cuts out for itself a valley is more rapid than that of the sea in cutting out cliffs. One of the steepest slopes which I observed any portion of a volcanic cone to have was that in the small cone rising from the upper crater of Cha-cha-nobori, which had an inclination of 37° . This inclination would indicate, I think, that the cone is formed of extremely fine materials and that the last eruption by which these materials were formed had not been so violent. It is of course possible that the steepness of such a slope may be partly due to an internal rocky core. Another steep slope is that of Mount Nobu. For measuring the slopes of regular volcanic cones I would suggest the use of a circular protractor with a pendulum from its centre and a slit in its flat edge, the edge of the mountain being looked at through this slit. My own experiences in determining the height of a mountain by ordinary trigonometrical methods have been very unsatisfactory, the angular elevation of the mountain being too small to measure with accuracy.

The Kurile Islands in general (more particularly the smaller ones) slope toward the Pacific—the Okotsk shores of the island being the boldest and freest from off-lying reefs and rocks. The admiralty charts of the Kuriles are very imperfect, nearly every island being considerably out both in shape and position.

In looking at the Kurile Islands, we see that they form por-

tions of the long chain of volcanic mountains which bound the western shores of the Pacific. If we compare them with the group of volcanic mountains which we find to the north in Kamtschatka, or with the group we find in Japan to the south, we shall see that the volcanoes of the Kuriles are probably of more recent date. In Japan many of the volcanoes have become extinct, and since the first outbursts of volcanic rock I think that it can be very clearly shown that many stratified rocks have been deposited on their flanks. Besides these old volcanoes, there are in Japan many which are comparatively recent. Looking at the more recent stratified and volcanic rocks of Kamtschatka, it is probable that there has been a sequence in events not unlike that which seems to be indicated in Japan. As to what this sequence has been, I hope to explain in another paper.

In the Kuriles, on the other hand, the volcanoes are altogether recent, and, from what I saw, sedimentary rocks are as yet without existence.

In Japan many of the volcanoes have suffered so much by denudation that their original forms have in many cases been destroyed. In the Kuriles, on the contrary, the greater number of the more important mountains show a well-defined form. Their sides are covered with ashes, and they show those slopes which indicate that they have suffered but little since they were first built up.

Without going into a detailed description of the differences which exist between the mountains of Japan and those of the Kuriles, it seems evident that these latter must be regarded as being much the younger. As a whole, they are probably contemporaneous with the younger volcanoes of Kamtschatka and Japan. They are, so to speak, amongst the last of the links which together build up the volcanic chain which bounds the shores of the West Pacific.

Altogether in the Kuriles I counted about fifty-two well-defined peaks, and of these nine are certainly active. No

doubt there are many more—those which I have enumerated being only the mountains which I saw. All these mountains, from their shape alone, I should say are volcanoes ; and farther, from their shape we see that they must be of quite recent origin.

Besides these there were many mountains of irregular forms, which might also be classed as volcanoes ; and in addition to all these there must have been many mountains, both regular and irregular, which I had not the opportunity of observing. Altogether, in the Kurile Islands, the area of which is reckoned at 14,865 square kilometers, there is a collection of active and recently extinct volcanoes, as compared with the area on which they stand, equal to the groups we find in any other volcanic district. When we look at these mountains, we must remember that they represent so many orifices, by which material has escaped from beneath the superficial crust of the earth.

The work which has here been done in building up new land is, on the face of it, exceedingly great. If, however, we compare the volcanoes of the Kurile chain with those of Kamtschatka lying to the north, or those of Japan to the south, we shall find that these volcanoes of the older countries, Kamtschatka and Japan, as land formers, have done greater work, and raised up higher mounds above the level of the sea than anything we find in the Kuriles.

At first sight this would seem to indicate that the forces which are driving up material through these vents were waning in their powers, and that when mountains like Klutchewsk (16,500 feet) in Kamtschatka, or Fuji-yama in Japan (12,450 feet), were raised, the volcanic energy of the West Pacific was greater than when the smaller mountains of the Kuriles, whose elevation perhaps does not exceed 6,000 feet, were uplifted. First it must be observed that I have here compared the mountains of the Kuriles with mountains whose formation was probably contemporaneous ; and secondly that these latter mountains were built up from a land surface, whilst those of the Kuriles were probably built up from

the bottom of an ocean which is perhaps the deepest in the world.*

Looked at in this way, although the Kuriles may not have done so much as the more recent mountains of the groups lying to the north and south of them in adding to the land surface of the globe, they may represent vents from which as much material has been ejected, and this by forces just as powerful as any of more ancient date.

From the few specimens I collected, the rocks which have been erupted appear to be augitic andesites. These rocks are similar to those in Kamtschatka, Japan, Java, New Zealand, those described by Prof. Zirkel as characteristic of a large area in the 40th parallel, many in Hungary, and, in fact, they have a character in common with many volcanic rocks of recent origin, which have been collected in many parts of the world.

That we should find the same character of rock breaking out at so many points, and these in many cases along the same volcanic line, is extremely interesting.

In reading the description of the several islands, it must be observed that mention of streams of lava has been omitted. The absence of lava streams, as compared with the number you find in a country like Iceland, is very striking, and at the same time suggestive of the way in which these island have been built up.

From the small number of mountains which are still giving off steam, as compared with those which are apparently quite extinct, it would seem that the activity of the Kurile chain is fast becoming spent. Why a volcano should become extinct is an interesting speculation. Probably it is that by giving off vapours its energy is becoming exhausted. Another suggestion would be that, by building up cones of great height, it gradually destroys itself by its own increasing hydrostatic pressure. If this were the cause, we should expect to find that

* The soundings made by the *Challenger* gave for one of the depths to the east of the Kuriles 27,930 feet—the deepest sounding in the Pacific.

when the forces were no longer strong enough to force up the column of lava which fills the tube they have built by piling up ashes, they would find a point of weakness in its sides, and parasitic cones would be formed. When we see such parasitic cones it is not at all unlikely that they may indicate an extinction of visible volcanic energy by means of hydrostatic pressure.

Nature, however, when working geological changes of this description, works under variable conditions, and if it were possible for us to determine with certainty the reason why the various volcanoes have become extinct, we should find that a complication of causes had been in operation, and in no two cases ought we to expect to find agencies which had been anything more than approximately the same.

CONCLUSIONS.

I.—MAP OF VOLCANOES.

Among the more important results which have been arrived at has been the compilation of the accompanying map. For assistance other than that mentioned in the preceding pages I have to thank Mr. Tsunashiro Wada, Director of the Geological Survey, who has already drawn up a map of the Volcanoes in Japan, Mr. N. Fukushi, Director of the Survey Department in Yezo, and my own private assistant, Mr. Matoba Naka. The following tables form a key to the map:—

KURILE ISLANDS.

NAME.	REMARKS.
1. Shumshu	Somewhat flat island.
2. Alaid	A well formed cone. Erupted in 1770 and 1793.
3. Paramushir	Contains two well formed cones and three or four less prominent peaks. Erupted 1737, 1742, and 1793. One cone steaming.
4. Shirinki	A dilapidated cone and ridge.
5. Makanrushi	Contains five or six rugged peaks rising from the mass.
6. Onekotan	Contains two well formed cones.
7. Kharimkotan	Contains one well formed cone. Erupted 1883.
8. Shaiskotan	Contains five or six peaks. Erupted 1855. Two cones steaming.
9. Ekarma	Contains one fairly good cone and a ridge.
10. Chirimkotan	Contains one fairly good cone. It steams, and lava occasionally flows.
11. Musisir	
12. Raikoke	Dilapidated cone. Erupted 1778 and 1780.
13. Matau	A very well formed cone. Erupted 1878. Lava flows occasionally. Steaming.

KURILE ISLANDS.—Continued.

NAME.	REMARKS.
14. Rashau	Several rugged peaks. One peak steaming.
15. Ushishir	One peak steaming.
16. Ketoy	Several irregular peaks. Two are steaming.
17. Simshir	Three well formed cones, Prevost peak being very noticeable. Violent eruption at the South end in September, 1881. One peak steaming.
18. Makanruru	
19. North Brother	Two good cones. One dilapidated. Violent eruption May and June, 1879. Two peaks steaming.
20. South Brother	One dilapidated peak. (The active peaks shown on the map refer to the North Brother No. 19.)
21. Urup	Three good cones, with very many more or less conical peaks rising from the interior. Two peaks steaming.
22. Iturup	Five good cones, with many imperfectly formed cones. Violent eruption in 1883. Two peaks steaming.
23. Kunashir	One good peak.

NOTE.—There are therefore at least 23 well formed volcanic mountains, and 16 mountains yet steaming in the Kurile Islands. Kurile is derived from the Russian *kooreet*, to smoke. The Aino name for the Kuriles also means The Smokers.

VOLCANOES OF YEZO.

NAME.	HEIGHT IN FEET.	REMARKS.
1. Iwo-san		Active. There is here a cauldron of boiling mud and sulphur. The mountain is irregular in outline.
2. Kusuri		Regular form.
3. Oakan		Active. Regular.
4. Meakan		
5. Nisuikawoshipe	7,000	Between Nisuikawoshipe and Tourawoshi there is a range of unnamed volcanic peaks.
6. Obutatishike	7,500	
7. Kushambitz		Active.
8. Tourawoshi		
9. Ofui	3,450	
10. Shokambitz	7,200	
11. Yubari		Here there is a group of volcanic peaks.
12. Shakotan		
13. Raiden	3,250	
14. Iwo-san	3,600	Active.
15. Shiribitz		Active. Regular.
16. Iniwa		Active.
17. Tarumai		Active. Volcanic cone eruption in the spring 1874. October 7th, 1883, January 4th, 1885 April 28th, 1886.
18. Shiraoi		
19. Usu		Active. Well formed crater.
20. Noboribitz		Active.
21. Obira		
22. Yurap	4,100	
23. Nigorikawa	2,700	
24. Komaga-take	3,380	Active. Volcanic cone regular on north side; well formed crater; eruption on June 27th, 1710. September 26th, 1856.
25. Esan	1,920	Active. Irregular. Sulphur deposits.
26. Rishiri		
27. Oshima		
28. Koshima		

NOTE.—There are therefore in Yezo at least 28 Volcanoes. Of these three or four are regularly formed and eleven are still steaming.

VOLCANOES OF HONSHIU AND KIUSHIU.

NAME.	HEIGHT IN FEET.	NATURE OF ROCKS.	REMARKS.
1. Osori-san	3,200	Augite andesite with a little hornblende and quartz.	On Osore-san there is a solfatara. Yake-yama has a well defined form; a third crater is broken. There is a crater lake here.
2. Iwaki-san	5,260		Last eruption 1848. Regular form. Crater somewhat worn.
3. Hakko-san			Three craters.
4. Herai-dake			One crater.
5. Nakui-dake			Volcanic nucleus.
6. A mountain between Nanashizure and Anhidake			Volcanic nucleus.
7. A mountain west of Biobudake			Volcanic nucleus.
8. Ganju-san	7,000		Last eruption 1824. Regular cone, with crater slightly steaming.
9. Komaga-take			Regular cone.
10. Moriyoshi-zan	5,800	Basalt and augite trachyte.	Well formed with crater.
11. Mikoma-dake			Well formed, with crater.
12. Sukawa-dake			Well formed, with crater.
13. Chokai-zan	7,100	Basalt, augite andesite with a little hornblende.	Regular cone, with three craters.
14. Gas-san			Volcanic nucleus.
15. Arakami-yama			Two peaks (Arakami and Funagamine), and two craters.
16. A mountain to the N.W. of Arakami-yama			Volcanic nucleus.
17. Neshiroishi-yama			Crater and cone.
18. Zōō-san			Crater and cone.
19. Kokuzo-san			Volcanic nucleus.
20. Adzuma-san			Four craters.
21. Adachitaro			One crater.
22. Bandai-san	5,800	Augite andesite with a little quartz.	Last eruption 807. Irregular mountain with old lava streams and broken crater. Covered with vegetation.
23. Nasu-dake	6,300		A solfatara and boiling stream. In eruption about 1880.
24. Shiowara-dake (Takahara)			Crater and cone.
25. Nekko-san	8,500	Augite andesite and basalt.	Five craters. Nantai-san, Shirane-san (8,500 ft.) in eruption in June, 1872. Irregular crater. Komanako, Nyobo, Yu-dake, a solfatara.
26. Hiuchi-dake			Cone and crater.
27. Sumon-dake			Cone and crater.
28. Komaga-take			Cone and crater.
29. Nayebaga-take			Cone and crater.
30. A mountain N. W. of Kusatsu			Cone and crater.
31. Mioko-san			Two craters, one a solfatara.
32. Yake-yama	7,800	Andesite.	Cone and crater; near the top a solfatara. No lava, well formed.
33. Kurohime-yama	6,900		Cone and crater.
34. Renge-san	9,800		Two craters; Renge and Nosikusa.
35. Akagisan	6,045	Augite andesite.	Two craters, one broken. A crater lake.

VOLCANOES OF HONSHIU & KIUSHIU.—*Continued.*

NAME.	HEIGHT IN FEET.	NATURE OF ROCKS.	REMARKS.
36. Haruna-san	3,438	Quartz, hornblende, andesite (dacite) hornblende, andesite.	A crater lake. Altogether five craters. A solfatara.
37. Kusatsu-yama...	6,500	Augite andesite, with a little olvine.	Three craters with walls to form lakes. Sulphur deposits. Cone and crater.
38. Adzuma-san			Well formed. Three craters; one, which is very deep, is steaming violently. Last eruption about 1870.
39. Asama-yama	8,800	Augite andesite.	Volcanic nucleus (?).
40. Mtogi-san			Two cones and craters (Yatsugadake and Tate-shima.)
41. Yatsuga-dake	9,114	Basalt with augite andesite with little hornblende.	Volcanic nucleus.
42. Raya-dake			Two craters broken. Solfatara, irregular form. Last eruption 794.
43. Tate-yama	9,400	Granite near base. Augite andesite, with hornblende also with quartz.	
44. Iyakushi-dake...			A complete crater.
45. Yake-dake	7,953	Andesite.	Three cones and craters (Yakedake, Kasa-dake, Iwo-dake). Near top a solfatara, well shaped, no lava.
46. Norikurayama...	10,447	Augite andesite, with hornblende.	Three craters with lakes on top. Black scoria and lava flows.
47. Mitake	10,000	Obsidian, perlite, augite andesite, with hornblende.	Five craters. Weathered and rugged on the top.
48. Haku-san	8,947	Half way up sandstone. Augite andesite with quartz.	Two craters and solfatara. Craters with water, sulphur deposits.
49. Fuji-san	12,400	Anorthite, basalt.	Last eruption 1707. Regular form with a crater 600 feet deep. A little steam escapes.
50. Ashidaka-yama.			Two craters.
51. Hakone-yama	4,474	Basalt and augite andesite.	Three craters (Kamuriga-dake, Komaga-dake, Futago-yama), crater lakes.
52. Amagi-san	4,700	Obsidian, augite andesite, basalt.	
53. O-shima	2,500	Augite andesite.	Last eruption 1876. Crater gives off steam.
54. Nii-shima	1,400		
55. To-shima	1,730		
56. Miake-shima			Last eruption 1876. Black flat-tish cone.
57. Mikura-shima			
58. Hachijō	2,840		Last eruption 1789-1801.
59. Aoga-shima	1,500		Distinct crater. Vegetation on the cone and in the crater.
60. Daisen		Augite andesite.	Cone and crater.
61. Mikame-yama...			Cone and crater.
62. Futago-yama...			Cone and crater.
63. Tsumuri-san			Last eruption 867. Five craters and peaks, one solfatara.
64. Hiko-san			Volcanic nucleus.
65. Kiucho-san			Four cones and craters (Kuro-dake, Kiuchosan, Waiitayama, a solfatara).
66. Aso-san	5,000	Augite andesite, basalt.	Large crater 10 miles diameter (central cone steaming).
67. Tara-dake			Broken crater.
68. Onsen-dake		Hornblende andesite with a little quartz.	Broken crater and solfatara. Last eruption 1791. Irregular form.

VOLCANOES OF HONSHIU & KIUSHIU.—Continued.

NAME.	HEIGHT IN FEET.	NATURE OF ROCKS.	REMARKS.
69. Kirishima-yama	4,816	Augite andesite.	Last eruption 1772. Well formed. Eleven complete craters.
70. Sakura-jima.....	3,060	Augite andesite glass.	Three craters.
71. Ikeda-yama	3,069	Augite andesite.	Four craters (Kaimon-dake, 2 solfatar s.)
72. Hirakiki-yama ..			Last eruption 1615.
73. Iwoga-shima ...	2,331		These islands are yet active. There are other islands in the chain stretching towards Formosa, of Volcanic origin.
Yerabu-shima	2,297		
Naka-shima.....	3,400		
Kaminone.....	972		
Yoko-shima	1,700		
Iwo-shima	541		

In Honshiu, Kishiu and the southern islands there are at least 78 volcanoes. Out of these about twelve have well formed cones and twenty-four are still steaming.

2—NUMBER OF VOLCANOES.

Because Japan has not yet been completely explored, and because there is considerable difficulty in defining the kind of mountain to be considered as a volcano, it is impossible to give an absolute statement as to the number of volcanoes in this country. If under the term volcano we include all mountains which have erupted within the historical period, those which have a true volcanic form, together with those which still exhibit materials on their flanks, which have been ejected from a crater, traces of which can still be seen, we may conclude that there are *at least* 100 such mountains in the Japanese Empire. These mountains are distributed as follows:

Northern Region	{ Kuriles	23
	{ Yezo	28
Central Region	{ Northern Honshiu }	35
	{ Central Honshiu }	
	{ Oshima Group }	
Southern Region	{ Southern Honshiu.....	1
	{ Kiushiu.....	13
	{ Southern Islands }	
Total.....		100

If we add to our list the ruins and basal wrecks of volcanic cones, this number is considerably increased.

The number of mountains which are easily recognizable as being of volcanic origin as given in the map is 129.

Of this number about 51 are still active, that is to say, are

now giving off steam. These active volcanoes are distributed as follows:—

Northern Region	{ Kuriles ... 16 }	}	27
	{ Yezo 11 }		
Central and Southern Region.....			24
	Total.....		51

Out of the 129 volcanoes, 39 are symmetrically formed cones.

The greatest proportion of regularly formed mountains and of mountains yet giving off steam are in the Kuriles. From this it may be argued that the mountains in the north are younger than those in the middle and south.

3.—NUMBER OF ERUPTIONS.

Altogether in the preceding pages about 233 eruptions have been recorded. The distribution of these in the different districts, and with regard to time, is shown in the accompanying table. The greater number of records in the southern districts, as compared with the northern districts, may be accounted for by the fact that Japanese civilization advanced from the south. In consequence of this, records were made of various phenomena in the south, while the northern districts were unknown and unexplored regions. The greater number of eruptions have taken place in the months of February and April. Comparing the frequency of eruptions in the different seasons, the volcanoes of Japan appear to have followed the same law as the earthquakes; a greater number of eruptions having taken place during the cold months. This winter frequency may possibly be accounted for in the same manner that Dr. Knott accounted for the winter frequency of earthquakes. During the winter months the average barometric gradient across Japan is steeper than in summer. This, coupled with the piling up of snow in the northern regions, gives rise to long continued stresses, in consequence of which certain lines of weakness of the earth's crust are more prepared to give way during the winter months than they are in summer.

ERUPTIONS IN RELATION TO MONTHS AND SEASONS.

SOUTHERN DISTRICT.

	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Un- known.	Total.
Aso-san	2	12	2	5	3	2	4	8	4	2	6	9	8	67
Sakurajima	—	1	1	4	1	—	2	2	5	2	2	1	6	27
Kirishima	—	1	2	—	1	—	—	1	—	—	1	2	17	25
Tsumuri-zan	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Onsen-dake	—	—	—	—	—	—	—	—	—	—	1	—	—	1
Islands near Sa- tsuma	2	—	—	—	1	1	1	—	1	1	—	1	3	11
Hirakiki-yama ...	—	—	—	1	1	—	—	1	—	—	2	—	1	6
Kiushiu District..	4	14	5	10	7	3	7	12	10	5	12	13	36	138

CENTRAL DISTRICT.

Vries Island Group	1	1	2	—	1	—	2	1	—	—	1	2	7	18
Fuji-san	—	—	—	2	—	1	—	1	—	—	—	1	6	11
Asama-yama	3	2	—	4	1	1	2	1	—	1	2	1	4	22
Tate-yama	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Natsu-yama	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Ganju-san	—	1	—	—	—	—	—	—	—	—	1	—	—	2
Iwaki-zan	1	1	2	4	—	—	—	—	—	—	—	—	—	8
Central District...	5	5	4	10	2	2	4	3	—	1	4	4	19	63

NORTHERN DISTRICT.

YEZO:—														
Komaga-take	—	—	—	—	—	1	—	—	—	1	—	—	—	2
Tarumai	1	1	1	—	—	—	—	—	—	1	—	—	—	4
KURILE ISLANDS:—														
Alaid	—	1	—	—	—	—	—	—	—	—	—	—	—	2
Paramushir	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Makanrushi	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Shaiskotan	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Ikarma	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Chirimkotan	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Matau	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Raikoke	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Rashau	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Ushishir	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Ketoy	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Simushir	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Brat Chirnoi	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Urup	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Iturup	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Kunashiri	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Northern District.	1	2	—	1	—	1	—	—	1	1	—	—	25	32
Total	10	21	9	21	9	6	11	15	11	7	16	17	80	233
	40			36			37			40				

Winter Months 80
 Summer Months 73
 Unknown 80

4.—POSITION AND RELATIVE AGE OF JAPANESE VOLCANOES.

The youngest of the Japanese volcanoes appear to be those which exist, as or on small islands. On the islands in the Kuriles, in the Oshima Group, and in the Satsuma Sea, many of the volcanoes are yet young and vigorous. Farther, many of these islands have been formed during the historical period. The island forming period in the Satsuma Sea occurred about the year 1780.

Looked at generally, the volcanoes of Japan form a long chain running from the N.E. towards the S.W. A closer examination of the distribution of the volcanic vents shows that there are probably four lines.

1. The N.E. S.W. line running from Kamschatka through the Kuriles and Northern Yezo.

2. The curved line following the back bone of Honshiu and terminating on the western side of the Yezo anticlinal.

3. The N.N.W. S.S.E. line of the Oshima Group. This line, coming from the Ladrones, passes through Oshima and Fujisan parallel to and near to the line of a supposed fault. Here it intersects the main line running through Honshiu. Volcanic vents are here very numerous. As the Honshiu line is intersected, while the Oshima line is the intersector, it may be argued that the Oshima-Fujisan line of volcanoes are younger than many of those on the Honshiu line.

4. The Satsuma line, coming from the Philippines through Sakurajima and culminating in the famous Mount Aso, which is the nucleus of Kiushiu.

5.—LITHOLOGICAL AND CHEMICAL CHARACTER OF LAVAS.

Although I have made an extensive collection of the volcanic rocks of this country, opportunity has not hitherto presented itself for their examination. I can therefore only speak of them in general terms. They are now, I believe, being

carefully studied by the officers of the geological survey of Japan. The rocks in my possession are chiefly andesites. Those containing augite, like the rocks of Fuji-san, as pointed out by Mr. Wada, the director of the geological survey, closely approximate to basalts. True basalt, is however, rare. Another common rock is hornblende andesite, some of which contains free quartz. Quartz trachytes occur in the north of Japan. The following table, which is chiefly drawn up from material kindly placed at my disposal by Mr. Wada, shows the percentages of silica and ferrous and ferric oxide contained in the rocks of ten volcanoes.

PERCENTAGE OF SiO_2 , FeO AND Fe_2O_3 IN THE VOLCANIC ROCKS OF JAPAN.

LOCALITY.	SiO_2	FeO	Fe_2O_3
1. Norikura	61.72 ...	1.35 ...	3.50
2. Mitake	59.97 ...	3.27 ...	3.86
3. Kusatsu (near Zi goedo Amiguchi)	61.49 ...	3.30 ...	4.35
4. Amagi (Hakone).....	65.34 ...	2.45 ...	3.09
5. Komagadake	56.27 ...	2.19 ...	6.69
6. Moriyoshi	56.17 ...	2.65 ...	4.15
7. Chokai	{ 60.64 ...	3.81 ...	3.14
	{ 54.55 ...	5.19 ...	4.42
8. Hakone (Tonosawa)	48.97 ...	4.02 ...	4.81
9. Fujisan	49.00 ...	5.1 ...	6.06
10. Oshima.....	52. ...	13.70?	

One feature exhibited by the table is, that the rocks of Oshima, Fuji-san, and Tonosawa are basic, while those like Chokaisan and Moriyoshi-yama, belonging to the Honshiu line of volcanoes, are relatively acidic. More extended observations of this description may show that different lines of volcanoes have erupted different lavas, or that the lavas of different constitution are of different ages.

6.—MAGNETIC CHARACTER OF ROCKS.

Mr. E. Kinch, when speaking of the soils in the neighbourhood of Tôkyô, makes special reference to the magnetite they contain. A great portion of this comes from the disintegration of volcanic rocks. Many of the Japanese lavas have a distinct effect upon a compass needle. The black lavas from the crater of Fuji-san will deflect the needle of an ordinary

compass through many degrees. Many of the pieces of lava are not only magnetic, but they are polar. Dr. E. Naumann found a block of augite-trachyte on the top of Moriyoshi-san which would deflect the needle of a compass through 155° .

The most curious observation made by this investigator was that the magnetic declination near to Ganju-san has during the last 80 years (when it was about 14.30° E.) decreased 19° , it now being about 5° W. As we recede from this mountain the amount of change has been less. Assuming this result to be correct, it would seem justifiable to look towards Ganju-san as connected with these local changes. Some of the volcanoes in the Kuriles are said to exert a marked influence upon the compasses of ships. When a vessel is lying near certain mountains, as for instance in Bear Bay, at the north end of Iturup, a distant mountain will have a very different bearing to that which is indicated by the same compass when the vessel is a short distance outside Bear Bay.

In both cases the ship may be lying in the same direction, and the direction of observation is practically along the same line.

This leads me to repeat a suggestion that I have several times made during the last few years, namely, that a magnetic observatory be established on or near one of the more active volcanoes of this country. Many of these volcanoes, like that of Oshima (Vries Island), lie in the track of so many vessels that to determine whether local and rapid changes in magnetic declination are taking place in these localities appears to be a legitimate investigation. Changes in volcanic activity are probably accompanied by local changes in the magnetic effects produced by subterranean volcanic magmas. These changes may be due to alterations in position, alterations in chemical constitution, and changes due to the acquisition or loss of heat. If such is the case, the records of a magnetic observatory would lead us to a knowledge of changes taking place beneath the ground. When we remember that volcanoes like Oshima

(Vries Island) lie in the track of so many vessels where it seems probable that there may be local and rapid changes in magnetic variation taking place, it seems that the suggested investigations have a practical as well as scientific aspect. An investigation of earth currents at and near volcanoes might be added to the magnetic investigations.

7.—INTENSITY OF ERUPTIONS.

Judging from the accounts of eruptions which have been given in the preceding pages, it would appear that the intensity of volcanic action in Japan has been as great as in any other portions of the world. One period of unusual activity was between the years 1780 and 1800, a time when there was great activity exhibited in other portions of the world. It was during this period that a portion of Mount Unsen was destroyed and from 27,000 to 53,000 persons perished; that many islands were formed in the Satsuma sea; that Sakurajima threw out so much pumicous materials that it was possible to walk a distance of 23 miles upon the floating *débris* in the sea, and that Asama ejected so many blocks of stone, some of which are said to have been from 40 to over 100 feet in diameter, and a lava stream 68 kilometers in length.

8.—THE FORM OF VOLCANOES.

The form I particularly refer to, is the regular so-called conical form, which is very noticeable in many of the Japanese mountains, especially perhaps in those of recent origin. Outlines of these volcanoes, as exhibited either by sketches or photographs, show curvatures which are similar to each other. In the Kurile Islands I have had opportunities of comparing two volcanoes by so altering my position until one of the mountains partially eclipsed another standing at no great distance in the background. One of these mountains was Otosoyama (Mount Fuss). The other mountain, like many of the peaks in the Kurile Islands, is without a name.

From a collection of photographs, I traced the profiles of a number of important mountains in this country. These profiles

are repeated in this paper. From an examination of these figures I found that the curvature of a typical volcano was logarithmic, or in other words the form of such a mountain was such as might be produced by the revolution of a logarithmic curve round its asymptote. In my original paper on this subject, I said that the form agreed with that which would be produced by the piling up of loose material. As pointed out by Mr. George F. Becker, in a paper on the form of volcanic cones, &c. (*American Journal of Science*, October, 1885), I ought to have said it was the form due to a self supporting mass of coherent material. Mr. Becker continues my observations by an analytical investigation of the conditions of such equilibrium. If the height of a column is a , its radius y , the distance of any horizontal plane from the base x , the specific gravity of the material r , and the co-efficient of resistance to crushing at the elastic limit k , then the equation of the curve which, by its revolution about the x axis, will generate the finite unloaded column of "least variable resistance" is

$$\frac{y}{c} = \frac{e^{-\frac{x}{c}} - e^{\frac{x}{c}}}{2}$$

$$\text{Where } c = \frac{2k}{r}$$

This latter quantity is of course different for different materials. It can be expressed in terms of x and y

$$\frac{2k}{r} = \frac{y}{(\tan^2 d - 1)^{\frac{1}{2}}}$$

d being the angle which the tangent at any point makes with the x axis.

The value c can be obtained from photographs or drawings of a mountain, while r may be obtained from pendulum experiments or from specimens of volcanic material. With this data we can determine the modulus of resistance for the elastic limit of the materials which compose a mountain on a large scale, for many constituents of the earth's crust.

Mr. Becker concludes his observations by remarking that a

study of the form and dimensions of lunar volcanoes would lead to values of $\frac{k}{r}$ whence we might approximately determine whether the lunar lava is similar to that of terrestrial origin.

In the following table I have followed out Mr. Becker's suggestion and calculated "the modulus of resistance to crushing at the elastic limit" in lbs. per square foot for a number of Japanese mountains. (1) The different values for $\frac{2k}{r}$ for the same mountain is in great measure due to my not being able to obtain an accurate scale for the various photographs which had to be investigated. Another difficulty was obtaining a value for r or the density of the mountain. Professor T. C. Mendenhall, who made a number of experiments with pendulums on the summit of Fujiyama, says the rocks of that mountain have a density of 1.75. This is when they have air in their pores. As powder, the density becomes 2.5. Wada gives the specific gravity of the rock on Fuji-san as 2.6. Assuming the density of the earth at 5.67 (Bailey), then the density of Fuji-san, as determined by Professor Mendenhall's experiments, is 2.08. In my calculations for the following table I have assumed a density of 2.5 for the materials of all the mountains mentioned.

	Height in feet.	$\frac{2k}{r}$	$\frac{k}{r}$	Load in lbs. per square foot.	Kind of Profile examined.
Fuji-san	12,441	4,200	—	—	Photograph.
	—	5,000	—	—	Photograph.
	—	4,240	—	—	Photograph.
	—	3,500	—	—	Photograph.
	—	5,420	—	—	Photograph.
	—	5,450	—	—	Photograph.
	—	5,440	—	—	Photograph.
	—	3,945	—	—	Photograph.
	—	4,133	—	—	Photograph.
	—	4,430	—	—	Surveyed section.
	—	3,640	—	—	Surveyed section.
Average for Fuji-san ...	—	4,490	2,245	350,220	
Iwaki-san	5,260	2,360	1,180	174,080	Photograph.
Nantai-zan	3,800*	2,000	1,000	156,000	Photograph.
Alaid	7,773	2,195	—	—	Photograph.
Alaid	—	2,120	1,078	163,168	Photograph.
Krakatoa (Java).....	2,745	1,310	—	—	Photograph.
		1,310	655	102,180	Surveyed section.

* This is the height above Lake Chuzenji.

(1) It will be noticed that there is difficulty in defining the quantity $\frac{2k}{r}$, as calculated from the shape of a mountain. It is assumed that the materials are not crushed.

Comparing the results given in the above table with the numbers in the following table, which are based on experiments referred to in *Rankine's Civil Engineering*, we may say that the average strength of Fuji-san lies between that of rubble work and sandstone. Iwaki-san, Nantai-san, and Alaid are like good rubble masonry, while the strength of the ill-fated Krakatoa is not much above that of ordinary brickwork. In making the above calculations I have used :—

1. The profiles of volcanoes traced from photographs which I used in my original communication on the forms of volcanoes published in the *Geological Magazine*. *Plate 3*.

3. A series of tracings from photographs of Fuji-san and other mountains not hitherto published *Plate 2*. For most of these a scale can be obtained. The best scale for Fuji-san is probably the difference in height of Hoyei-san and the summit. Hoyei-san is a parasitic crater on the southern side of Fuji and in the profiles is marked H. This difference in height is about 4,137 feet.

A scale may also be obtained from the line of sea level or from the diameter of the crater which is about 750 meters.

Two profiles of Fuji-san from the surveys of Mr. O. Schütt are also given.

Causes modifying the natural curvature of a mountain and therefore interfering with the above calculations are :—

1. The tendency, during the building up of the mountain, of the larger particles to roll farther down the mountain than the smaller particles.

2. The effects of atmospheric denudation which carries materials from the top of the mountain down towards the base.

3. The position of the crater and the direction in which materials are ejected.

4. The existence of parasitic craters on the flanks of a mountain.

5. The direction of the wind during an eruption.

6. The sinking of a mountain in consequence of evisceration beneath its base.

7. The expansions and contractions at the base of a mountain due to the acquisition or loss of heat before and after eruptions.

9.—THEORETICAL MOUNTAINS.

As it might be interesting to compare actual mountains with theoretical mountains constructed from the equation

$y = \frac{c}{2} \left(e^{\frac{n}{c}} - e^{-\frac{n}{c}} \right)$ such mountains have been drawn. They are shown in *Plate 2*.

The values of c are given in the following table :—

In drawing up the table, I have taken the instantaneous breaking strength of granite and its crumbling strength, which is the largest possible value for k , as being equal. For sandstone I have assumed the crumbling strength as being $\frac{3}{4}$ of the breaking strength, while for rubble work and brickwork it has been taken as one half. (See *Rankine's Civil Engineering*, p. 361, &c.)

Material.	Instantaneous breaking strength in lbs. per sq. ft.	Crumbling strength or k in lbs.	Weight. Cubic foot lbs.	$c = \frac{2k}{\gamma}$.
Granite	1,584,000	1,580,000	170	18,500
Sandstone	790,000	590,000	144	8,200
Rubble Masonry	316,000	150,000	120	2,500
Brickwork	144,000	72,000	112	1,300

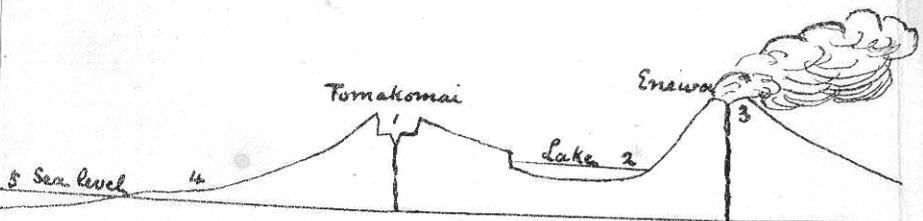
The diameter of the base of each of these mountains is 48,000 feet, and the height to which mountains of the following different materials could be built upon such a base without crushing would approximately be :—

Brickwork	4,600 feet.
Rubble Masonry	7,300 feet.
Sandstone	14,500 feet.
Granite	20,000 feet.

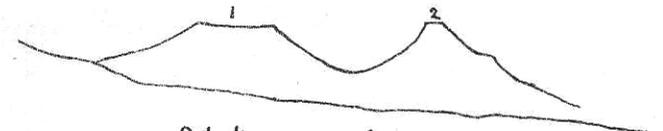
10.—EFFECT OF VOLCANIC ERUPTIONS ON THE PEOPLE.

The eruptions in Japan have from time to time exerted a very marked influence upon the minds of the Japanese people.

Divine interference has been sought to prevent eruptions, priests have been ordered to pray, taxes have been repealed, charities have been instituted, special prayers against volcanic disturbances have been formulated and have remained in use for the period of one hundred years, while special days for the annual offering up of these prayers have been appointed. At the present day there is a form of worship to mountain deities not uncommon, which may have had its origin through the fear created by volcanic outburst. Displays of volcanic activity have certainly intensified this form of worship.



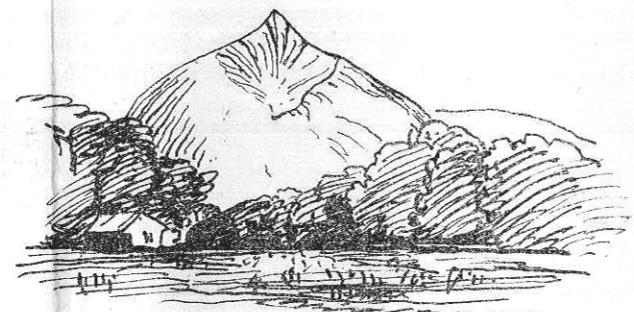
Cross section at Tomakomai



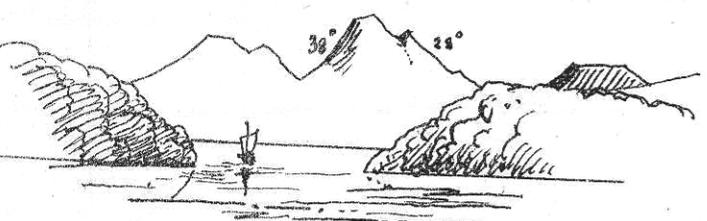
Odaka and Medaka, looking NE.



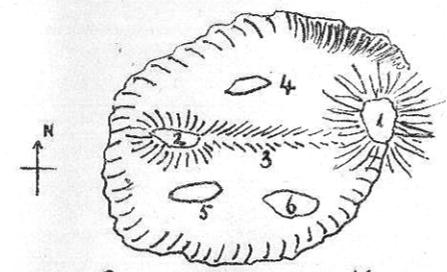
Taromai Volcano.



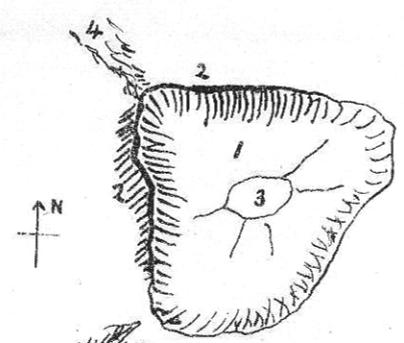
Enewa from the WSW.



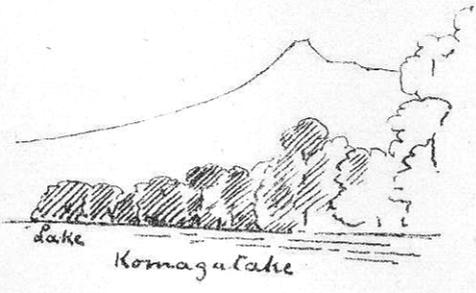
Usu Volcano from Mororan Harb.



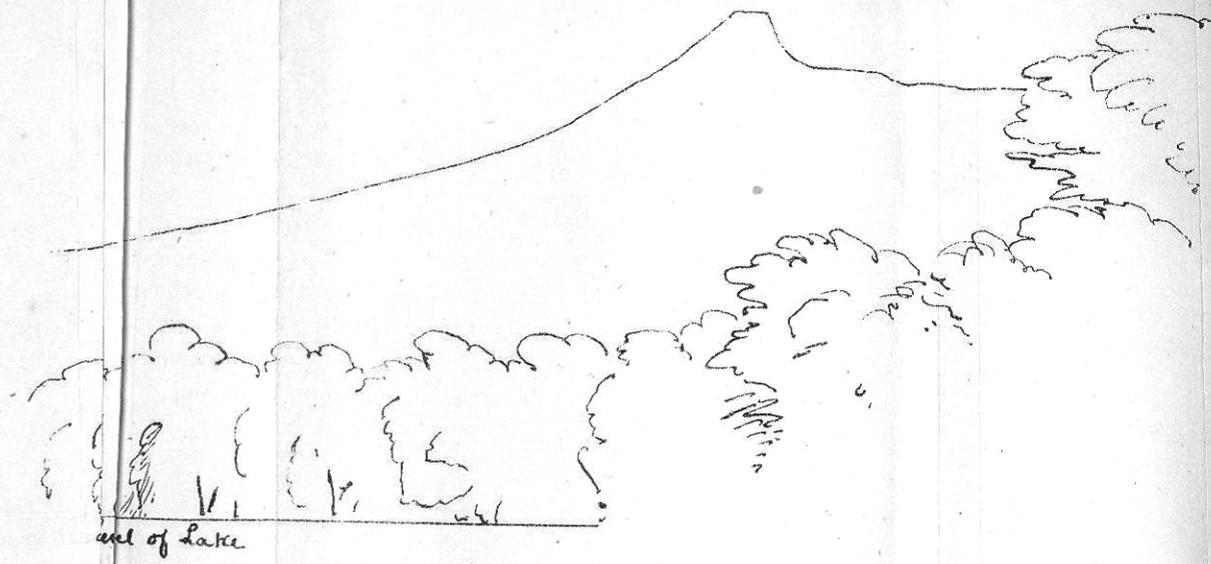
Plan of Crater of Usu.



Plan of Crater of Komagatake

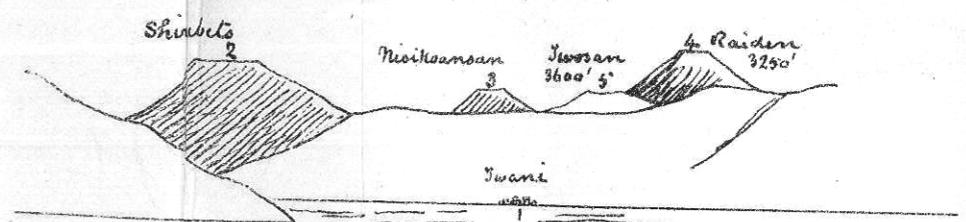


lake Komagatake



end of lake

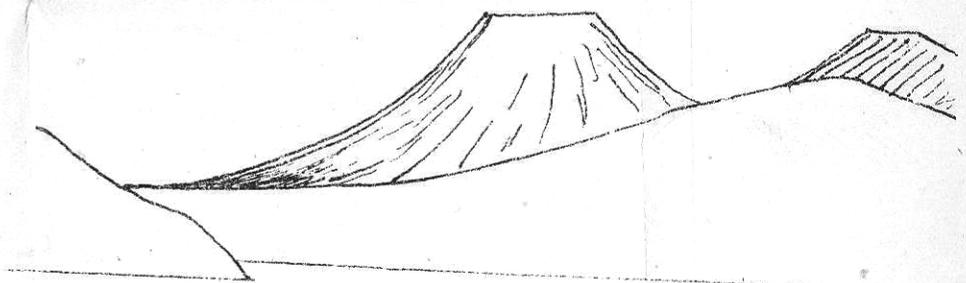
Komagatake



Looking S20°W from off Jusanai



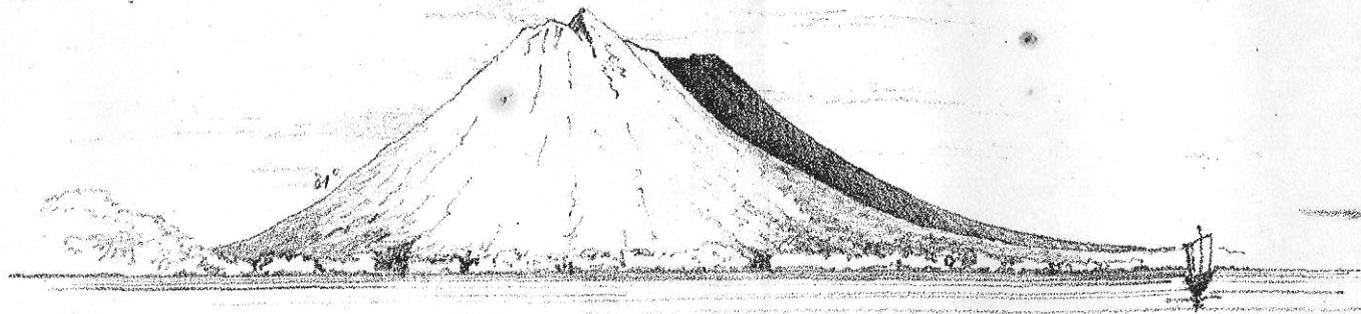
Island of Oshima



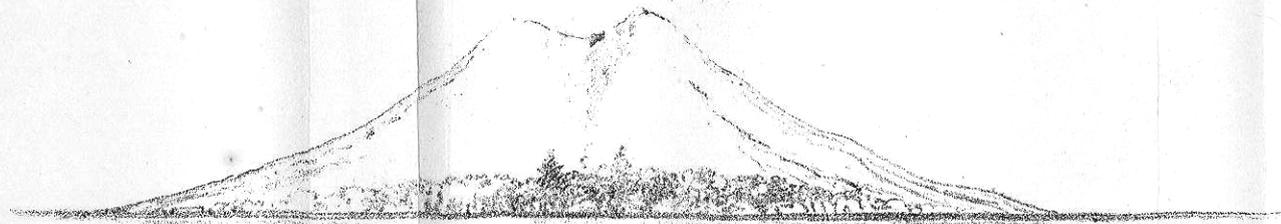
Shirabetsu from near Kayonoma.

Esam from near Cape Blunt.

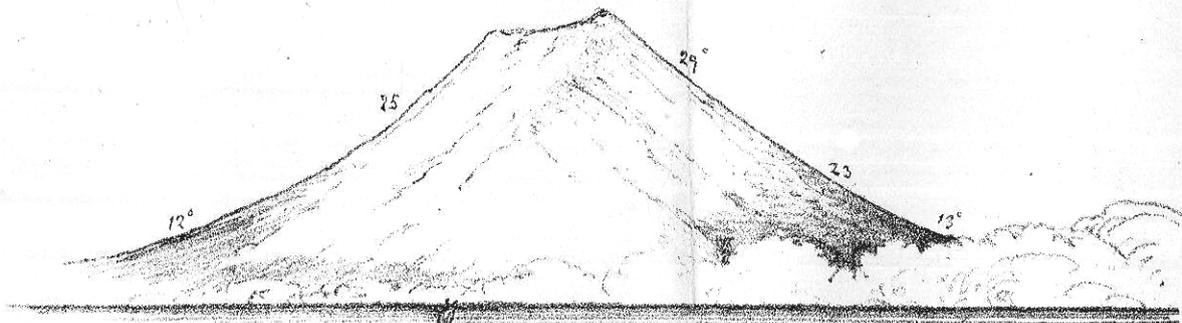
Plate 7



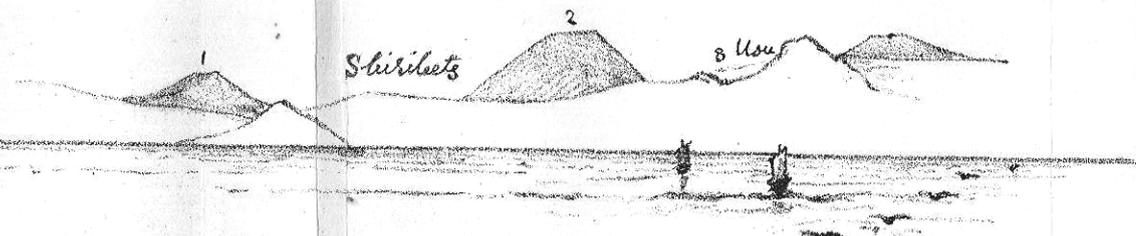
Otoskoyama, W side
(Mountains showing similar curvature)



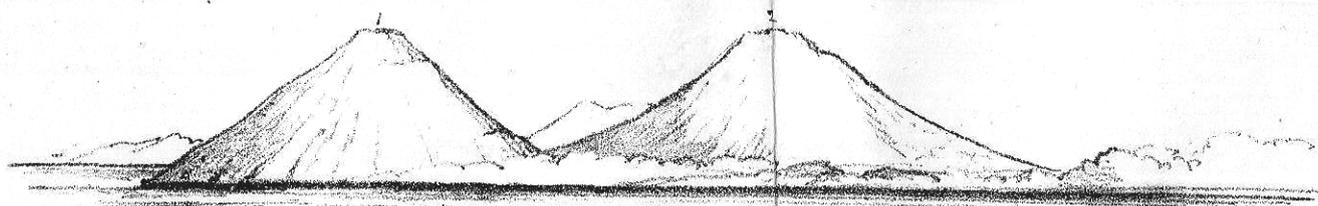
Komagatake from Volcano Bay.



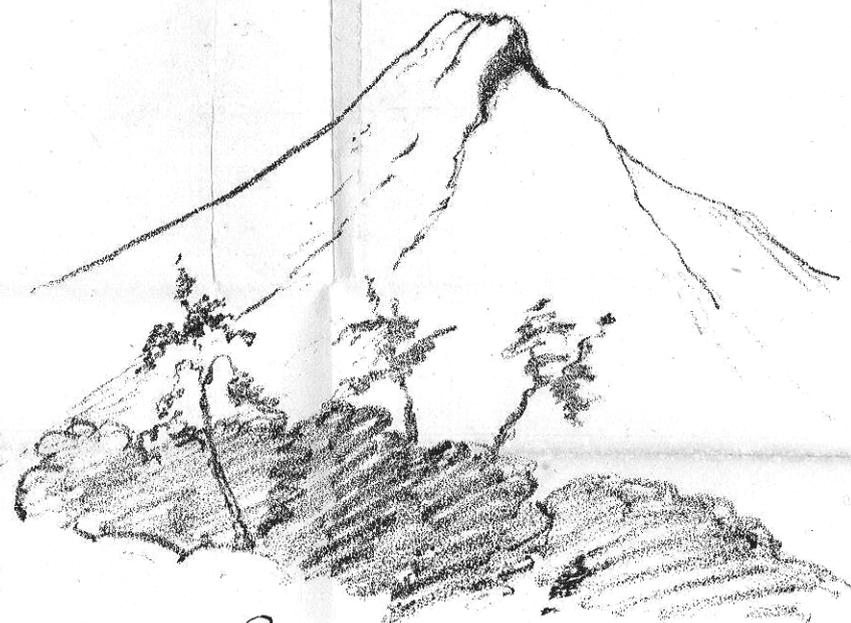
Ulaid looking SW. (7773 ft)



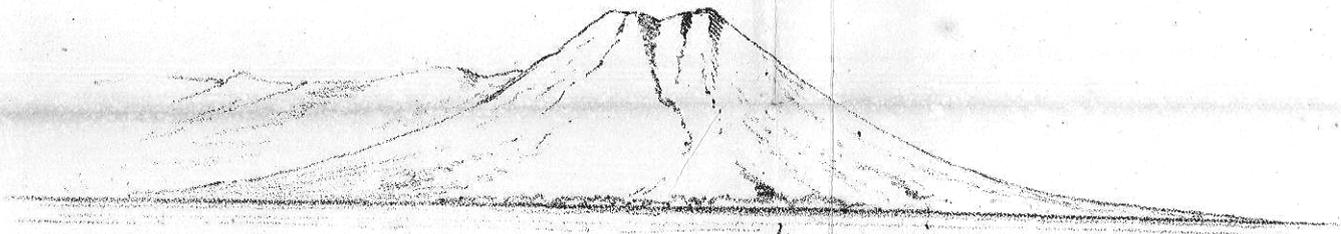
Crossing Volcano Bay



1. Otoskoyama (4050 ft) 2. Stokup



Peak of Komagatake
From the road between the lakes and Inari.



Next to Otoshodake

THE VOLCANOES OF JAPAN

Strike lines ← →

Volcanic Rocks 

Active Volcanoes  

