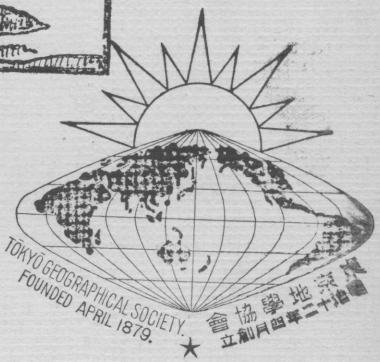
GUIDE-BOOK EXCURSION B–2

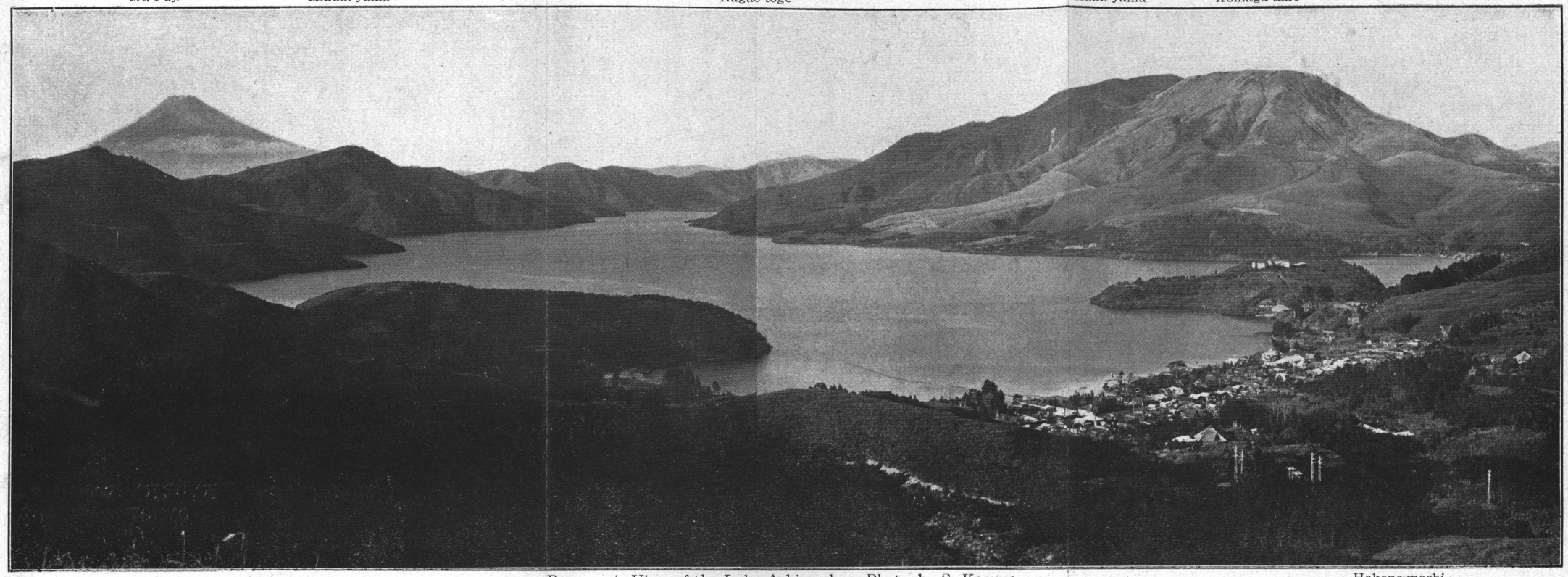
(Oct. 26th–27th, 28th–29th, 1926)

HAKONE



PAN-PACIFIC SCIENCE CONGRESS, 1926

JAPAN



Panoramic View of the Lake Ashi-no-ko. Photo. by S. Kasuya.

HAKONE

CONTENTS

GUIDE TO THE BOTANY OF THE HAKONE MOUNTAINS

By Bunzō Hayata

I. TOPOGRAPHY.

In the central part of the Main Island of Japan, between Mt. Fuji and the Peninsula of Izu, stands the mountain-group of Hakone, representing one of the most magnificent examples of a compound volcano in the Japanese Empire, comparable in its grandeur only with the Aso mountains in the Island of Kyūshū, and even surpassing them in its beautiful flora. The vicinity is very famous as a resort at every season of the year, owing to the hot springs which occur in several places in the region. For botanists, it is one of the most interesting districts as it possesses, on account of the very varied topography and of the complicated geological structure, nearly all types of mountain vegetation, such as meadows, forests, bamboo clumps and marshy and lacustrine formations. The flora of this region is very rich, comprising, as it does, more than one thousand species of vascular plants. It is in fact representative of the flora of the middle districts of the Main Island of Japan, with the exception of that of very high altitudes and of shore regions.

It was my great good fortune to be given an opportunity to make a general survey of the botany of these interesting mountains, the results to be used in lieu of a guide book for an excursion to Hakone, to be arranged by the Congress. Generally speaking, the vegetation is, as it were, a garment covering a body of mountains of more or less complicated geological structure. Consequently in order to enable my readers to understand the botany of these regions, it is, in the first place, most important to describe the mountain-system of Hakone. Allow me to say a few words about the topography, only so much as is necessary for our purpose.

The mountain-group of Hakone is, broadly and generally speaking, a truncated cone, standing nearly on the level of the sea, of no great height, but of a very wide base, with several central cones on the stunted top (Fig. 1). Its basal area, or the area occupied by the piano, is of an elliptical shape in its vertical projection. The major axis of the base lies north and south, and the minor axis east and west. The former is nearly 23 km. and the latter nearly 20 km. long and the area occupied by the piano in the vertical projection is nearly 361 sq. km. or 36,100 hectares. The height of the cone is or, more precisely speaking, the heights of the circus mountains are, not very eminent, the highest peak, Kintokiyama, being 1,213 m. above the level of the sea.

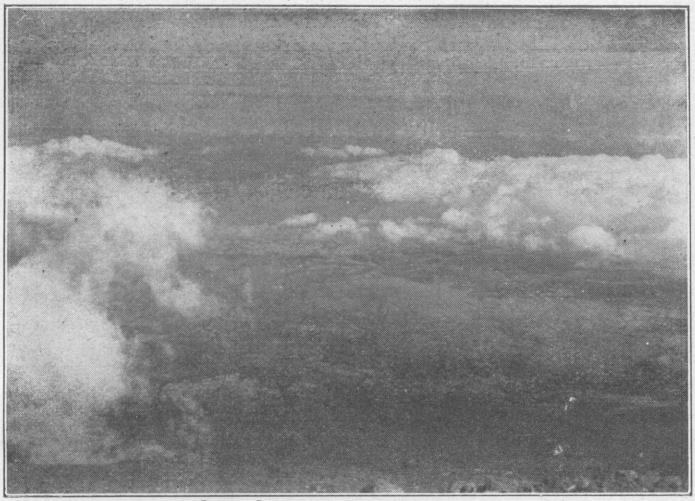


Fig. 1. Distant view of the Hakone mountains from an altitude of 3.000 m. on the eastern flank of Mt. Fuji. Yaguradake is seen at the base of the left flank of the mountains; the other peaks are hidden by the gathering clouds. Phot. B. HAYATA, Sept. 15, 1925.

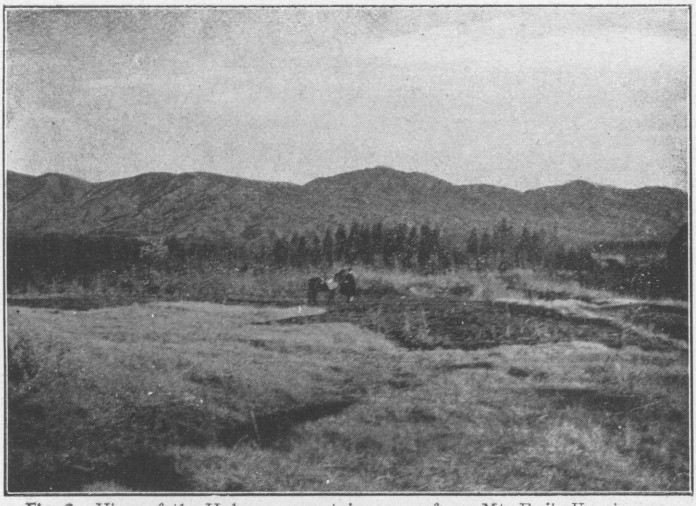


Fig. 2. View of the Hakone mountains, seen from Mt. Fuji; Kamiyama, one of the central cones, with its lateral prominence, Kammurigatake, is seen above the circus mountains. Phot. B. HAYATA, December 1, 1925, Inno.

The edge of the truncated top, which varies in height from 1000 m. to 1200 m., forms a nearly complete circle, being broken only on the east. Two streams, the Hayakawa and the Sukumogawa, which, starting one at each end of the atrial lake, have cut out barrancoes on the inner side of the truncated cone, meet on the east. The erosive power of the united rivers has at this point forced a passageway through the mountain, thus breaking the circle. The area of the truncated top is, in its vertical projection, of an oval shape, the directions of the major and minor axes being the same as in the basement area. The area of the top is 61.5 sq. km. or 6150 hectares, the major axis being nearly 12 km. and the minor nearly 6.5 km. long. Bordered by the circus mountains, stand the central cones, the highest, Kamiyama, being 1439 m. above sea level.

II. GENERAL ASPECTS OF THE VEGETATION.

The vegetation, which I am going to describe, clothes this mountain body like a gown. To give a general idea of the vestment, I believe I shall be pardoned if I refer to my notes written on the spot concering the general aspects of the vegetation. Viewed from Subashiri a few miles to the northeast of Hakone, the group of hills seems to be a wide stretching mountain-range. One can hardly recognize it as a truncated cone. Yet, for all that, it is a cone with a very wide truncated top and an even wider base. Turning our attention to the northeastern foot of the cone, we see the gentle slope of the piano, apparently of meadow formation, slowly ascending, passing quite close to the front of the rounded cone of Yagura-dake (897 m.), extending up to the Ashigara pass (759 m.), and then higher up passing in front of Myōjinga-take (1165 m.), which drops a little behind, and terminating at last with Mt. Kintoki (1213 m.), the steepest and highest peak and the left end of the circi. Continuing our observation from the left to the right end of the truncated and interruptedly wooded top, we get the impression of an extensive range of mountains.

To enumerate from left to right, or from the northeast to the southwest, Kintoki-yama (1213 m.) lies on the left edge of the top; next to it is Nagao-yama (1144 m.), which is partly wooded; and then comes the rounded cone of Marutake (1164 m.), bare on the top. Again passing to the right, we see a series of prominences, more or

less wooded, of no great importance; and then Mikuni-yama (1102 m.) densely wooded towards the top; and finally the Yamabushi pass (1034 m.), quite bare on this side (facing us), and on the right (south-western) edge of the truncated cone. Then the right shoulder of the cone begins, descending slowly and sweeping the meadow-like foot of the compound volcano, till it comes to an end on the coast of the Pacific Ocean. Before our eyes, the northwestern slope and piano, mostly of meadow formation, gradually joins the fertile plain of Gotemba. Far above on the truncated top, stands one of the central cones, Kami-yama (1439 m.) (Fig. 2), crowned with dense forest, and a little behind it, is another, Komaga-take (1326 m.), partly wooded and partly bare.

Roughly speaking, the lower two-thirds of the vestment look like a grass formation, while the upper one near the truncated top seems to be a forest formation. The latter formation consists of several patches of forest, each being of an obtriangular shape, hanging from the ridge of the circi, broad at the top, but tapering towards the base to a gracefully curving line and thus descending along the valleys to the meadows below.

From these notes, rough as they may be, we may form a conception of the general aspect of the vegetation of the Hakone range. Let us now come nearer and observe it more in detail. A closer examination will show it to be very complicated. In order to explain its various features, it may perhaps be most convenient to make a classification of the vegetation, considering at the same time the factors controlling its variation.

III. CLASSIFICATION OF THE VEGETATION, WITH REFERENCE TO THE GEOLOGICAL FACTORS.

During my first visit to these beautiful mountains in the spring of last year, I found the vegetation so very complicated that I was quite at a loss how to describe clearly and accurately the botany of these regions. After studying the topography and geology, I paid my second visit to the same mountains in the beginning of the summer. I took then the route for Hakone from Gotemba, over the Otome pass (1000 m.) which passes a depression of the ridges of the truncated top, between Nagao-yama (1144m.) and Maru-take (1153m.).

Fig. 3. Geological map of the Hakone mountains, showing the distribution of the different kinds of rock to be studied in connection with the distribution of the different types of vegetation. After the geological map compiled by Prof. T. HIRABAYASHI, simplified.

Descending to the fresh green meadow of Sengokuhara, I passed dwarf bamboo clumps and forest patches. Looking up I saw the central cones, Daiga-take, Kammuriga-take and Kami-yama, all clad with dense forests on one side, but with meadows or dwarf bamboo clumps on the other. Then I ascended a green slope where the mud-flow had dushed down, as it were, from the side of Kamiyama, admiring as I went the grandeur of the scenery surrounding the *atrio* and the central cones. Climbing up the slope, and entering a forest patch, I reached Ubago, a famous resort possessing a clear brine spring with a large half-natural, half-artificial pool, and stopped there for the night. It was late in the night when, as I was pondering over the classification of the varied vegetation I had seen the same day and the factors controlling it, the conclusion to the vexed problem came suddenly to my mind.

The vegetation under consideration, though of a very complicated nature, may be divided most conveniently into three types which correspond pretty well with the geological formations. It seems to me that, of all the factors controlling the vegetation, the edaphic is in the present case by far the most important. Before discussing the three types of vegetation, let us, therefore, consider the geology of the mountain-group, only so far as is necessary for our purpose.

According to Professor T. HIRABAYASHI, the Hakone mountain-group is a stratified compound volcano, erupting at first through the tuffite, emitting different kinds of lavas, agglomeratic lavas and rocks, sands and ashes, forming strata after strata, and at the same time throwing intermittently mud flows. The surface of the volcano is generally covered by sands, ashes or loams which may be the production of the volcano itself or may have come from a neighbouring mountain, such as Mt. Fuji. Examples of the latter case are clearly to be seen on the northern side of the compound volcano. The surface distribution of these different kinds of ground plays an important rôle in the range of the different types of vegetation. As this is not the place for a full discussion of the geology, I shall simply refer to the following map (Fig. 3), showing the distribution of the different kinds of lavas, agglomeratic lavas and rocks, tuffite, mud flows, and sands and ashes, which has been made by simplifying the map compiled by Professor T. HIRABAYASHI some twenty years ago.

Considering the vegetation and geology simultaneously, we may divide the vegetation into three kinds of formations :—

1. Grass formations, generally on loams or sands and ashes, mostly developing on the basal outside regions of the circus mountains, on the mud flows which have dushed, as it were, from the central cones and on the inner side of the crater-wall.

2. Dwarf bamboo formations, thriving for the most part on tuffite, agglomeratic lavas and rocks.

3. Forest formations, growing for the most part on the very rugged surfaces of different kinds of lavas.

Let me try to explain how it is that each different plant formation may be said in general to prefer, though there are many exceptions, a particular geological formation. This is, in my opinion, principally due to the fact that certain physical characteristics of the ground,- i. e. its comparative smoothness or roughness, evenness or raggedness, earthy or rocky condition, softness or firmness,—all these characteristics act as factors controlling the retention of rainfall. The more ragged the ground, the more it seems to retain water. Thus, on the ragged lavas we find forest formations. Grasses thrive on the smooth ground which retains water only in the growing season, but remains dry in the winter ; we therefore find meadows on the smooth ground of mud flows or on sandy or ashy grounds, as in the *atrio* or on the sandy ground on the outer side of the circus mountains. As the ground composed of tuffite, or of agglomeratic lavas and rocks is more or less rough and therefore more favorable to the retention of water, the dwarf bamboo formation occurs there. The wind, too, should be taken into consideration in this case. Raggedness prevents the wind from blowing over the ground, and consequently rough and uneven surfaces keep the moisture better than smooth ground. Thus, I am much inclined to think that the distribution of the different types of vegetation corresponds pretty well with that of the different kinds of rock. It may be contended that I lay too much stress on the edaphic factor in explaining the present state of the vegetation. But some others, in my opinion, overemphasize the secondary phenomena caused by human agency, such as cuttings or fires. To this question I shall return later.

Let us consider again the general distribution in the mountains of these different types. The best place to obtain a general view of the vegetation is from the top of the Otome pass (1000 m.) on a wall

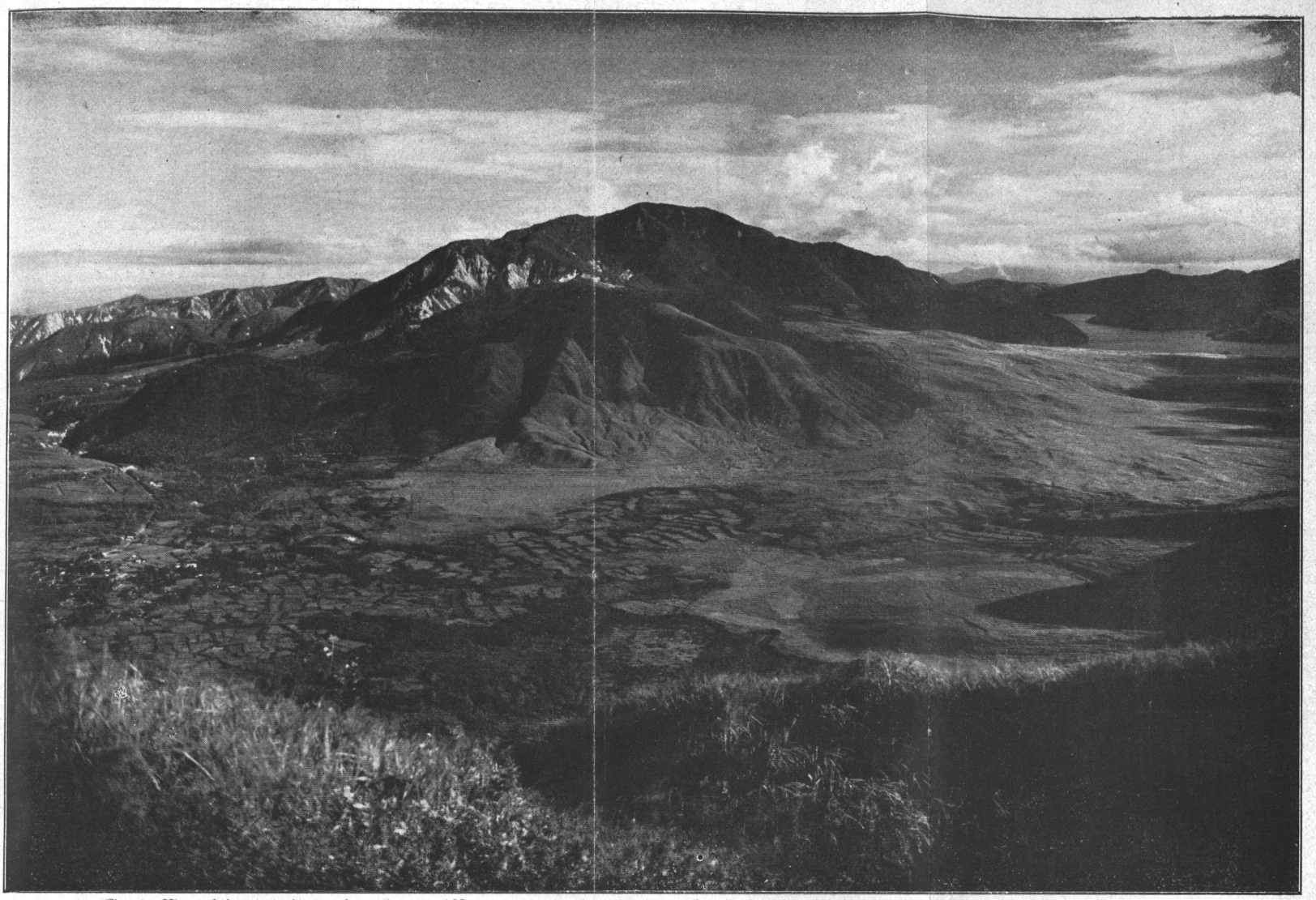


Fig. 4. View of the central cones from the top of Nagaoyama, showing the three different plant formations. The highest peak is Kamiyama (1438 m.); a little below on the left, stands Daigatake; mud flow from the middle of Kamiyama is seen on the right, occupied by grass formation; at the upper end of this formation, is located the hot spring of Ubako; below is the atrial plain. Phot. B. HAYATA, Sept. 15, 1925, with ray-filter No. 5, prepared for the demonstration of plant formations and other purposes of the kind by the Rikwagaku-Kenkyūjo.

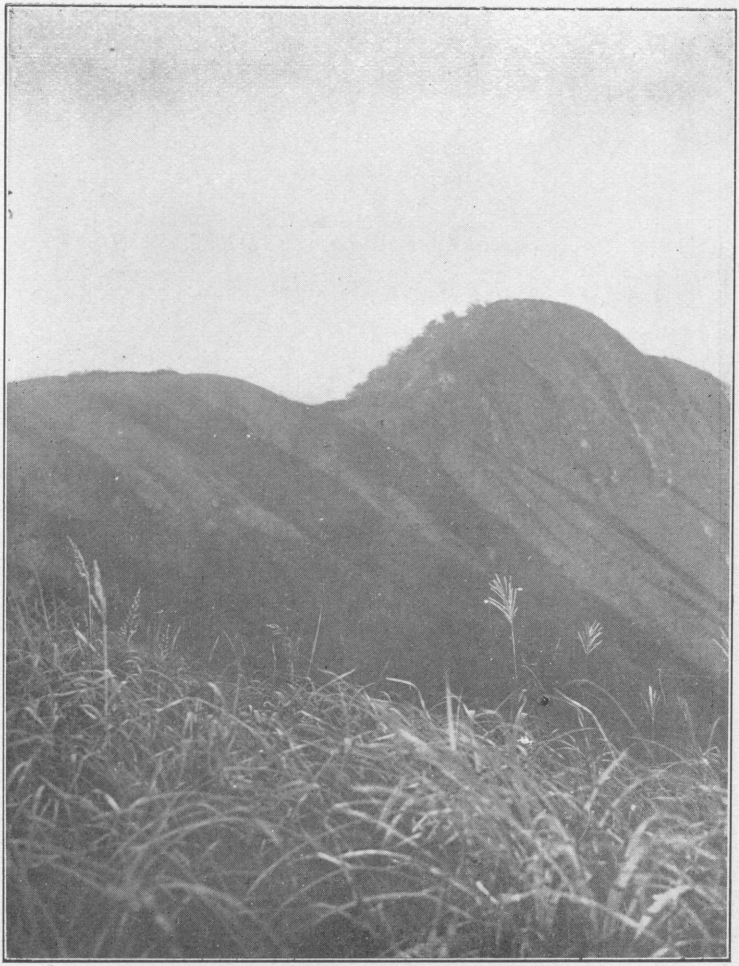


Fig. 5. View of Kintokiyama looking east from the top of Nagaoyama; in the foreground is a *Miscanthus* formation. Three panicles on the right side in the foreground are of *Miscanthus sinensis*, one on the left side of the center is of *Arundinella anomala* and three at the left end are of *Spodiopogon sibiricus*. Photo. B. HAYATA Sept. 15, 1925.

on the northwestern side of the crater. As accurate and plain speaking is most important in this case, I hope I shall be pardoned if I quote the following description from my notes written on the spot at the top of the same pass during my second visit to the mountains in the beginning of last summer (Fig. 4).

"On the south, across the *atrio* under my feet, lie the central cones. Far above, due south and in the center of the view, stands Kamiyama (1438 m.), the highest peak, seeming to culminate in the heavens with its lateral prominence, Kammurigatake, on the eastern side; and Komagatake (1350 m.), another central cone, seeming to drop behind the highest peak. Between Kamiyama and the *atrio*, rises Daigatake (1053 m.). To the east of it, stands Kozukayama (853 m.). On each of these central cones, is seen a forest formation, covering the summit like a cap. The forest-cap of Kamiyama sends its sylvan arms right and left down to the middle of the mountain or in some places even to the *atrio*. Inserted between Daigatake and Kozukayama, is a dwarf bamboo formation clearly distinguished from the meadows below by its dark green color. Other bamboo formations are found here and there in patches on the inside of the crater, on the central cones and also in the *atrio*. Far away beyond Kozukayama, I see Mt. Asama (820 m.) and farther away on the southeast, the densely wooded northern slope of Mt. Shirokane, one of the circus mountains.

"Turning my attention to the east, and pursuing other circi, I see in the distance Myōjōgatake (928 m.), and to the east of it and a little nearer to me, Myōjingatake (1165 m.). Much nearer I see Mt. Kintoki (1213 m.), the highest of the circus mountains (Fig. 5); then comes Nagaoyama (1144 m.), which gradually slopes down to the Otome pass (1000 m.) where I stand.

"Diverting my attention to the west, I see in the distance Uminodaira (941 m.), the most western mountain of the circi; a little nearer to me, the Yamabushi pass (1034 m.); then Mikuniyama (1102 m.); and finally Marutake (1153 m.), which lies on my right next to the Otome pass (Fig. 6). On the inner side of these circi now before my eyes, grassy formations generally occupy vast areas, leaving only the apical regions to the forests. Between these circi and the central cones, lies a very extensive *atrio*, including, as it does, on the east end, the picturesque hamlet of Sengoku; at the centre, the fresh green meadow of Sengokuhara; and on the west, the calm

waters of the atrial lake, Ashinoko (Fig. 7). The view of the grassy formations extending far and wide in the atrial plain and ascending nearly midway up Kamiyama along its mud flow, is the most magnificent I have ever seen in the mountains."

Comparing the distribution of the different types of vegetation as outlined in the foregoing description with that of the different rock formations as given in the map (fig. 3), we see clearly that there exists a general agreement between the botanical and geological formations, although there are seemingly many exceptions, which, however, may be considerably reduced after a close examination. In support of this view, I may here add one more case which I noted when passing along the western slope of Daigatake. On my right side, I saw grass formations on the mud flow, while on my left were bamboo formations on the agglomeratic rocks— a strong argument in favour of the contention that mud flow is suitable to grass and agglomeratic rocks to bamboo formations. I shall return to this matter later on. Meantime, I may repeat that I am inclined to think the edaphic by far the most important of all factors governing the vegetation of the Hakone mountain-group.

IV. OTHER CONTROLLING FACTORS.

The factors controlling vegetation may in general be classified as internal and external. As to the internal factors resulting in periodical changes in plant associations or, in other words, a succession of growths, which I believe to be by far the most important when a vast space of time is considered, I have not yet been given sufficient time to find out the extent of their influence over the present vegetation of Hakone.

Regarding the external factors, the edaphic having just been considered, there remains only the climatic to be discussed. But the latter factor plays a part of no great importance in the plant formations in so limited a region as Hakone. I may, however, submit a few points in this connection to be taken into consideration in discussing the present vegetation. As is generally well known, in the case of a mountain, the rainfall increases up to the altitude of 1,000 m. and then decreases above that limit, the rate of increase in every 100 m. being about 72 mm. in the annual mean of rainfall. The direction of the slope seems to play an important rôle in the formation of forests,

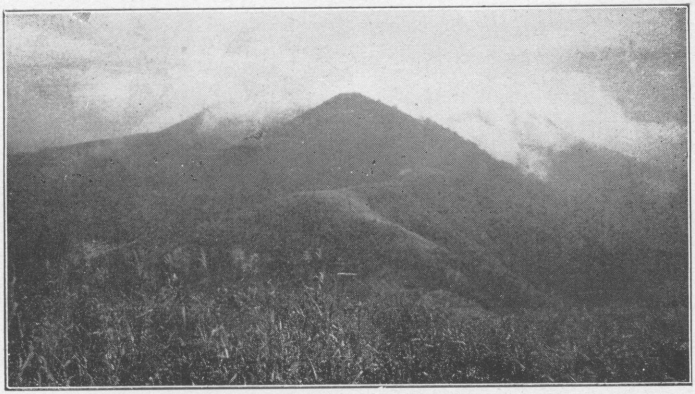


Fig. 6. View of Marutake, looking west from the top of Nagaoyama. In the foreground is a *Miscanthus*-formation consisting principally of *M. sinensis*, *Arundinella anomala* and *Brachypodium japonicum*. Phot. B. HAYATA. Sept. 15, 1925.

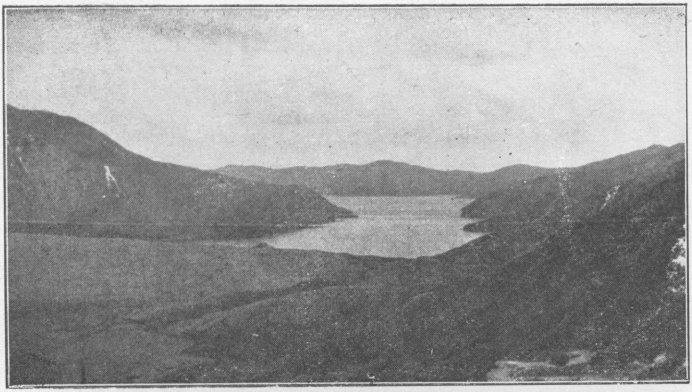


Fig. 7. View of Lake Hakone or Ashinoko, seen from the top of the Nagao pass. On the right side of the lake, are the eastern promontories of Mikuniyama; on the left, the western slope of Kamiyama, and far away in the background, the western group of the circus mountains, the highest, Mt. Kurakake, lying nearly in the center. Phot. B. HAYATA. March, 1924.

as the eastern side is generally cut off from the strong western wind, and therefore is naturally protected against too much desiccation; and the northern side enjoys the same protection against the sun, as the direction of the slope clearly indicates. These two factors, the increase of the rainfall in the regions near the summit and the protection against sun and wind on the northeastern side, may be taken, among many others into a consideration of which I am not going to enter, as a partial explanation of the better development of forests in the regions near the summit and on the northeastern side, as I mentioned in my notes made at Subashiri.

On account of limited space, statistics are given concerning rainfall and temperature only among climatic factors,[1] as observed at several stations at different places in the mountains. It is hoped that these data may be of some use in considering the different features of the vegetation.

TABLE I. (Rainfall)

Stations	Altitudes	Sides	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l.
Yumoto	100m.	E.	90	156	177	232	213	350	207	362	455	294	188	102	2,828
Odawara	30m.	E.	78	126	151	166	163	254	127	277	317	222	141	81	2,104
Matsuda	50m.	N.E.	69	114	135	152	152	207	148	319	324	213	138	73	2,043
Atami	49m.	S.S.E.	63	84	116	138	130	236	120	249	289	155	110	63	1,754
Manazuru	50m.	S.E.	66	97	143	152	166	236	142	298	301	189	125	75	1,991
Hakone	723m.		97	169	264	272	255	492	312	593	532	299	196	123	3,554
Numazu	7m.	S.W.	78	104	146	168	156	241	159	315	312	194	129	187	2,089
Gotemba	442m.	N.W.	85	145	174	208	144	310	181	342	292	221	142	94	2,337

Table I. shows the mean annual and monthly rainfall (in millimeters), covering, as in the next table, more than twenty years following the establishment of the stations; the altitudes together with the direction, in relation to the volcano, in which the stations are situated are also given. The station at Hakone is located nearly at the top of the slope of the volcano, i.e. on the southeastern side of the atrial lake; all the others are at the base of the mountains.

1) I am greatly indebted to Dr. T. Okada, Director of the Central Meteorological Observatory, for information about the meteorology of the Hakone mountain region.

Sketch map showing the meteorological stations in the vicinity of the Hakone mountains.

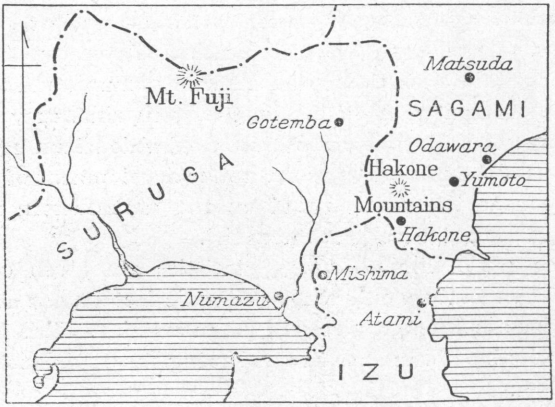


TABLE II. (Temperature)

Stations	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l.
Yumoto	5.3	5.4	8.1	13.2	16.6	20.6	23.9	24.8	21.9	16.1	11.5	7.4	14.6
Odawara	5.0	5.4	8.2	13.5	17.2	21.2	24.6	25.7	22.7	17.2	11.8	7.1	15.0
Matsuda	4.6	4.8	7.9	13.4	17.0	21.1	24.4	25.4	22.9	16.6	11.1	6.9	14.7
Atami	8.5	7.2	10.2	15.5	18.9	21.1	24.3	26.5	23.2	18.5	14.6	10.0	16.5
Manazuru	6.3	6.6	8.9	14.2	17.7	21.8	25.2	26.2	22.9	17.9	12.9	8.2	15.7
Hakone	0.0	0.4	8.7	8.4	12.3	17.2	20.7	21.2	18.2	12.6	6.8	1.8	10.3
Numazu	5.3	6.0	8.9	13.8	17.3	21.1	24.7	25.9	22.9	17.4	12.4	7.7	15.3
Gotemba	4.0	4.0	7.8	12.6	17.2	20.6	23.3	25.6	23.2	17.4	12.6	7.8	14.7

Table II. shows the mean annual and monthly temperature (C.) at the eight stations.

V. DESCRIPTION OF THE FORMATIONS.

Having thus classified the types of vegetation and considered the factors controlling them, let us examine each kind of formation more in detail.

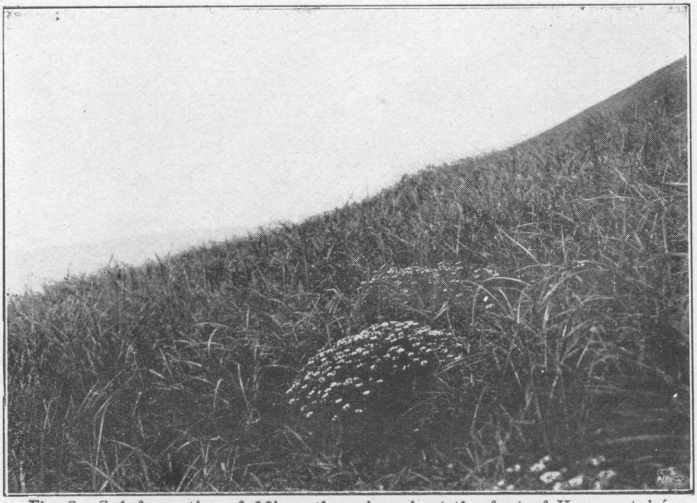


Fig. 8. Sub-formation of *Miscanthus sinensis* at the foot of Komagataké. *Aster trinervius* var. *vicidulus* in the *Miscanthus*-formation. Phot. B. HAYATA. Aug. 28, 1925.

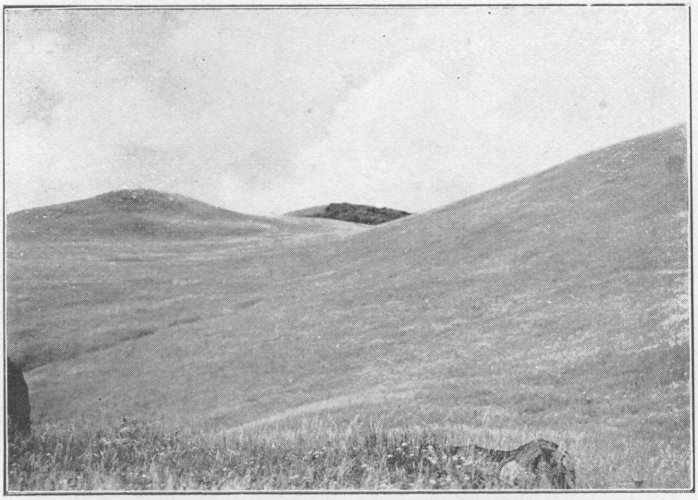


Fig. 9. Sub-formation of *Calamagrostis Langsdorffii* and *Miscanthus Matsumurae* on the top of Komagataké. Phot. B. HAYATA, Aug. 28, 1925.

a. Grassy formations.

This kind of formation may be divided into two sub-formations:— *Miscanthus* and *Calamagrostis*. The former sub-formation (Fig. 8), mainly consisting of *Miscanthus sinensis* with some *Arundinella anomala*, is commonly found in the basal regions of the circus mountains and the central cones, and in the atrial plain or on the mud flows; while the latter (Fig. 9), mainly composed of *Calamagrostis Epigeios*, *C. sachalinensis* and *C. Langsdorffii* with some *Miscanthus Matsumurae*, *Brachypodium japonicum* and *Spodiopogon sibiricus*, grows on higher elevations, such as the regions near the summit of the circi and the central cones. The sight of the *Miscanthus* sub-formation, when, late in the autum, the whole field of white woolly spikes is tossed into silver waves by the wind, certainly constitutes one of the most wonderful aspects of the Hakone mountains.

The plants found in the formation are as follows:—

Miscanthus sinensis,
M. sacchariflorus.
Arundinella anomala,
Calamagrostis Langsdorffii,
C. sachalinensis,
C. Epigeios,
M. Matsumurae,
Zoysia pungens var. *japonica*,
Agrostis tenuiflora,
Dactylis glomerata,
Holcus lanatus,
Phleum pratense,
Arrhenatherum avenaceum,
Lolium perenne,
Phragmites prostratus,
Ph. longivalvis,
Isachne australis,
Imperata arundinacea,
Arundinaria Chino,
Fimbristylis subbispicata,
Scirpus Mitsukurianus,
Scirpus Cyperinus var. *concolor*,
Patrinia scabiosaefolia,
Platanthera hologlottis,
Spiranthes australis,
Epipactis Thunbergii,
Lysimachia vulgaris,
L. clethroides,
L. Fortunei,
Indigofera pseudotinctoria,
Medicago sativa,
Trifolium repens,
Artemisia vulgaris var. *vulgatissima*,
Galium vernum var. *typicum*,
Lotus corniculatus,
Cirsium japonicum,
C. Hilgendorfii,
Lycopus Maackianus,
Lycopus virginicus var. *parviflorus*,
Scutellaria dependens,
Euphrasia Iinumae,
Hypericum crassifolium.
Plantago lanceolatum,
Rumex conglomeratus,
Rumex crispus,
Alisma Plantago var. *angustifolium*,
Lythrum Salicaria var. *genuina*,
Trifolim pratense,

Iris laevigata, *S. simplex*,
Onoclea sensibilis, *Drosera rotundifolia*,
Sphagnum cymbifolium, *Astilbe chinensis* var. *japonica*,
Sparganium longifolium, and others.

b. Dwarf bamboo formations.

These formations may after a close examination be divided into three sub-formations.

1. Sub-formation of *Arundinaria Chino*,
2. That of *Sasa ramosa*,
3. That of *Sasa borealis*.

The first (Fig. 10) and second sub-formations are usually found in open places, the former in the basal, and the latter in the regions near the summits of the circi and central cones; while the third, on the other hand, constitutes the undergrowth in the forests, being found only occasionally in open places after the woods have been cleared. The three species just mentioned sometimes grow together, but they usually occur in separate formations.

The extensive sub-formations of *Arundinaria Chino* in the Hakone mountains are very wonderful and almost unique in the Empire. In the dense clumps of this *Arundinaria*, other plants seem to find it very difficult to intrude. Exceptions are, however, found in the cases of *Ilex crenata*, *Pieris japonica* and *Illicium anisatum*. It is very curious to see from a distance these evergreen shrubs standing intermittently one after another in the wide stretches of the *Arundinaria* clumps, as if they were tea trees in a garden (Fig. 11). It seems that the seeds of the shrubs are distributed by birds, and, finding a favorable shelter in the dense thickets of the *Arundinaria*, they grow very rapidly above their nurses in order to enjoy the sunshine.

The question as to whether the bamboo formations are primary or secondary is rather a difficult problem and one to which I am not yet in a position to give any definite answer. Some are inclined to think that the present formations are secondary and that their development is largely due to human agency. Proof of this view is lacking, however, and I have not found any indication of forests' having been supplanted by the *Arundinaria* sub-formations after clearing. The sub-formation of *Sasa borealis* may be secondarily formed after clearing; the species, occurring naturally in shady places, cannot stand much sunshine. It extends over no very wide range in

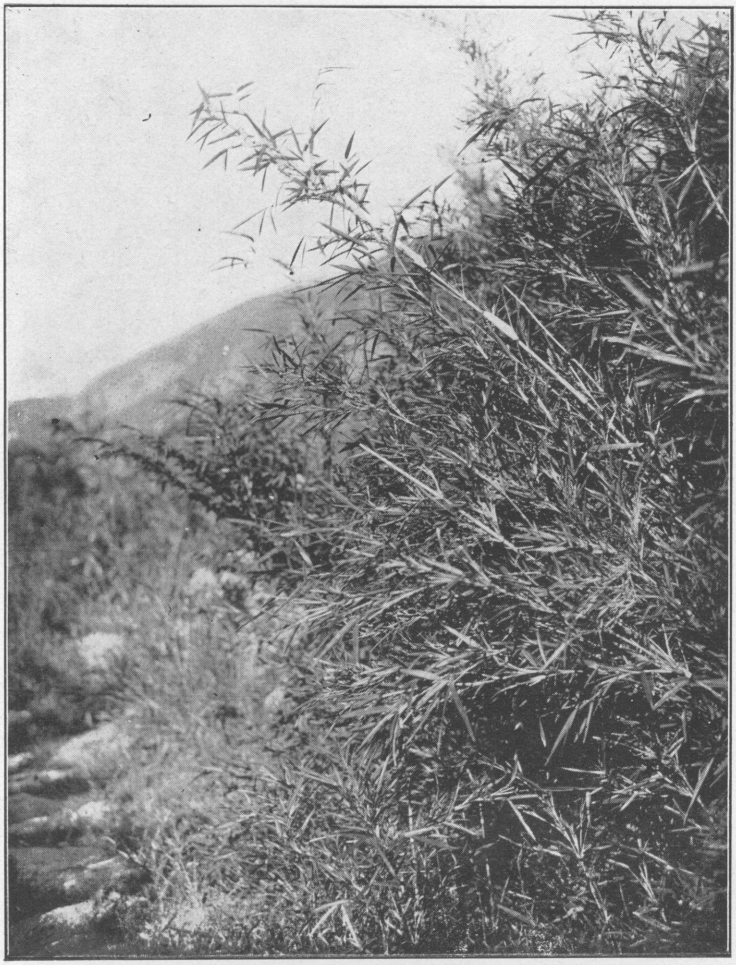


Fig. 10. Sub-formation of *Arundinaria Chino* MAKINO, near the Amasaki-jaya at an altitude of nearly 500 m. Phot. B. HAYATA, July 17, 1925, (9. x$\frac{1}{10}$).

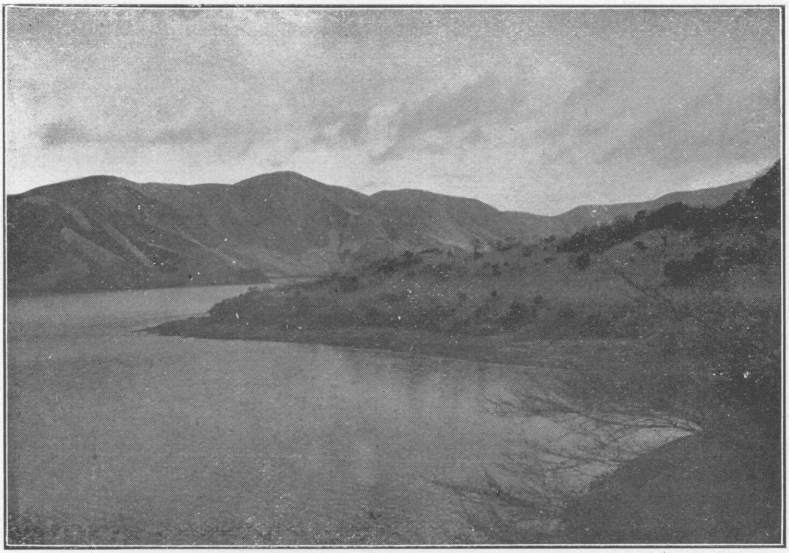


Fig. 11. Sub-formation of *Arundinaria Chino* MAKINO on the lake-side slope of Komagataké. On the right, we see the *Arundinaria* covering the hills; here and there in its midst rise evergreen shrubs, such as *Pieris japonica*, *Ilex crenata*, and *Illicium anisatum*, like tea trees in a garden. Phot. B. HAYATA, March 28, 1925.

Fig. 12. *Arundinaria japonica* SIEB. et ZUCC., at Gōra, at an altitude of 400 m. So far as I know, this is the only locality in Hakone where this species is found. Phot. B. HAYATA, March 28, 1925.

the Hakone mountains. *Arundinaria* is, on the contrary, a perfect light-loving plant, and covers a considerable area of tuffite and agglomeratic lavas and rocks. We never see the formations on ragged rocks or lavas, and seldom on the sands or ashes of mud flows. At present, I am rather inclined to think that the sub-formation of *Arundinaria* is of primary, while that of *Sasa* is of secondary origin. Besides these three sub-formations, there exist also some thickets of *Arundinaria japonica* which are not, however, very extensive (Fig. 12).

c. Forest formations.

These formations may be divided into two sub-formations, the one being composed of both deciduous and evergreen trees, and the other consisting mainly of deciduous trees. Formations of coniferous trees are entirely lacking in these mountains. This absence of conifers is all the more striking when we consider that there are a good many in neighbouring regions such as Mt. Fuji to the north and the range of Amagi to the south. The mixed sub-formation is found usually on the southern flank of the circus mountains or in the lake-side forests, while the deciduous sub-formation usually occurs in regions near the summit. The species found in the formations are as follows :—

among arbors,

Fagus Sieboldi,
Zelkowa hirta,
Stewartia monadelpha,
Meliosma myriantha,
Carpinus yedoensis,
Quercus crispula,
Magnolia obovata,
Acer pictum,

among shrubs,

Sapium japonicum,
Lindera umbellata var. *hypoglauca*,
Lindera praecox,
Salix gracilistyla,
Ilex Othera,
Clethra barbinervis,
Ilex crenata,
Viburnum Sieboldi,
Enkianthus campanulatus,
Symplocos crataegoides ;

and among woody climbers,

Hydrangea petiolaris var. *cordifolia*,
Euonymus radicans.
Schizophragma hydrangeoides,

VI. DISTRIBUTION OF THE DIFFERENT FORMATIONS.

a. In General.

The distribution of the different types of vegetation may be studied in the accompanying map (Fig. 13). Generally speaking, grass formations occupy the largest area, then come the forests and finally the dwarf bamboo formations. Grass formations are most abundant in the basal regions on the outside of the circi, and on the western and northern sides of the crater-wall. They exist also in the atrial plain and on the mud flows, and in some regions on the central cones. Forests usually occur in the summit regions on the outer and inner sides of the circi, and in some areas on the central cones. Dwarf bamboo formations occur most luxuriantly on the inner side of the southern extremity of the crater-wall and in the basal regions on the southwestern side of the central cones. They are also found in patches on both sides of the circi.

Let us again examine the maps, botanical and geological, to determine how far the distribution of botanical and geological formations agree. We shall first examine the grass formations. We have already stated that they grow mostly on sandy, ashy or loamy grounds. The most remarkable cases in point are: first, the immense meadow on the atrial plain of Sengoku; second, that occurring on the mud flow from Kamiyama; third, that of Miyagino; fourth, that of Hatagiku; and finally, that of Hakowamimura on the southern flank of the circi.

As to the dwarf bamboo formations, we have stated before that they thrive mostly on tuffites and on agglomeratic lavas and rocks. In support of this view, I may mention the formations on the tuffite of the inner slope of the southern extremity of the crater and on the agglomeratic lavas and rocks on the inner side of the northern extremity of the circi.

We have stated before that forests occur for the most part on different kinds of lavas consisting of large blocks of rock. In agreement with this statement, we find that forests thrive on the outer side of the circi and on the inner side of Mt. Shirokane, and on Kamiyama and Komagatake among the central cones. There are, to be sure, a good many cases of disconformity between the botanical and the geological formations. This fact is, however, principally ascribable to disturbances due to human agency such as overcuttings or fires, and also in part to my insufficient study of the botany, as well as to the imperfect geological surveys so far made.

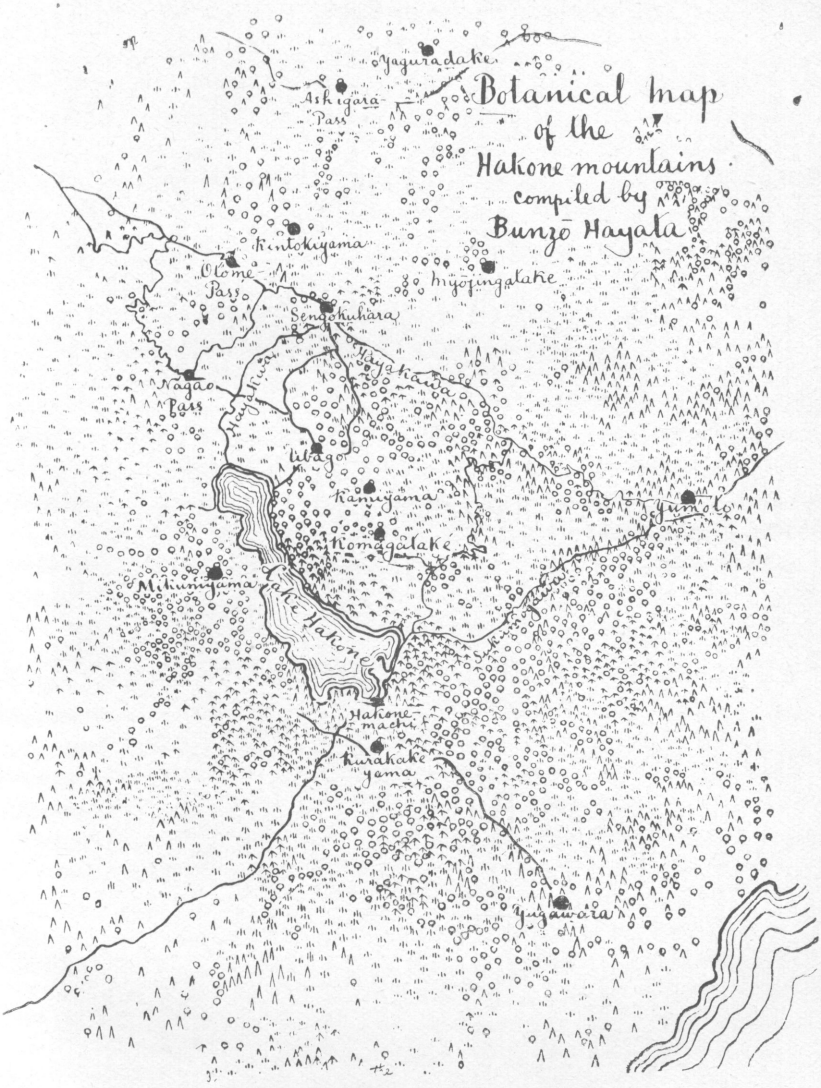


Fig. 13. Botanical Map of the Hakone mountains; compiled by Bunzō HAYATA.

Grass formation; Dwarf bamboo formation; Forest formation; Afforestations.

b. In detail.

After considering the general distribution of the different types, let us examine them more in detail, proceeding from one formation to another. For this purpose, it will perhaps be most convenient to describe the places, one after another, over which I travelled.

1. From Otome to Sengoku and to Ōwakudani.

Taking the route of the Otome pass from Gotemba to Hakone, we find generally, at the foot of the northern slope of the circi, some *Miscanthus* formations, with *Arundinella anomala*, *Imperata arundinacea* and *Galium vernum*. As we go upward, we see *Arundinaria* formations, among which are also *Ilex crenata*, *Illicium anisatum* and *Pieris japonica*. *Rosa Luciae* and *R. fujisanensis* are commonly found creeping over the exposed rocks. *Hakonechloa macra* is found in abundance unassociated with other plants.

As we go over the top of the pass and come down to Sengoku, we find *Styrax japonica*, *Deutzia scabra*, *Ilex crenata*, *Castanea crenata*, *Benthamia japonica*, *Ligustrum Ibota* and *Viburnum dilatatum*, with climbing plants such as *Lonicera japonica* and *Akebia quinata* and *lobata*. There are a number of clumps of *Arundinaria Chino*, and in some places also a few clumps of *Arundinaria hiratsukensis*. On our way from Sengoku to Ōwakudani, passing over the route between Daigatake and Kozukayama, we find some wonderfully thick bushes of *Arundinaria Chino*. Then we meet with a deciduous forest composed of *Fagus* and *Acer*, with a considerable quantity of *Pieris japonica*. In the shades of the forest, are found some plants of *Sasa borealis*. *Skimmia japonica* with its scarlet fruits may be found creeping on the ground. The only conifer to be found here is *Torreya nucifera*. On the front side of Daigatake is a forest consisting principally of *Stewartia monadelpha* which has a smooth reddish bark.

2. From Ōwakudani to Ubago and to Umijiri.

At Ōwakudani (1000 m.), we find exceptionally big trees of *Pieris japonica* and *Stewartia monadelpha*. Nearly pure stands of *Pieris japonica*, and a mixed forest of the same *Pieris* and *Ilex crenata* are met with. Descending a little from Ōwakudani towards Ubago, we find a deciduous forest consisting of several kinds of *Acer*, *Quercus crispula*, *Prunus incisa*, *Acanthopanax ricinifolium* and *Carpinus yedoensis*.

Sasa borealis constitutes the undergrowth. This species of *Sasa* is abundant in the shade of the forest, while *Arundinaria Chino* occurs alone in formations on the exposed ground. Between the forest clumps, there are several bare places, where a very rare plant of tropical nature, *Lycopodium cernuum*,[1] is met with. In the forests, there are considerable quantities of *Benthamia japonica*, *Pieris japonica* and *Ilex crenata*.

Among other shrubs, we find :—

Hydrangea hirta,
H. paniculata var. *versicolor*,
Deutzia scabra,
Aralia chinensis,
Viburnum dilatatum,
Stephanandra flexuosa,
Rosa fujisanensis,
Vaccinium hirtum,
Enkianthus campanulatus,
Diervilla floribunda,
Sorbus japonica.

Among ferns, *Dryopteris Phegopteris* and *Blechnum nipponicum* are most frequently met with.

Among herbs, *Perenanthes acerifolia*, *Shortia soldanelloides*, *Ligularia sibirica*, *Lilium auratum* and *Reynoutria japonica* occur. Among grasses, *Calamagrostis sachalinensis* and *C. Langsdorffii* are most common.

In the vicinity of Ōwakudani, we find lavas in some parts, but agglomeratic lavas and rocks or mud flows in other parts. On the mud flows and sands and ashes, we find generally grassy plots, and on lavas, forests. The following description was written on the spot as I was passing along from Ōwakudani on the 16th of July, 1925.

" On the west, we look down upon the northern extremity of the lake of Ashinoko. On our left stands Kammurigataké, on our right Daigatake. Far off, we see at the top of the inner wall of the western part of the crater of the compound volcano the pass of Umijiri (850 m.), the pass of Nagao (902 m.) and toward the right (on the northwest), Marutake (1153 m.). Around us, on the muddy ground, we see a grassy plot and a little distant on the rocky ground, a band of forest connecting the densely wooded flank of Daigataké with that of Kammurigataké. Farther away, on the north side of the lake, we see the grassy formations on the atrial plain of Sengoku. On the inner side of the crater opposite the lake, are seen some *Arundinaria* formations on the agglomeratic rocks, with a grassy plot caused by cuttings."

1) The distribution of this tropical plant is very curious. It is found in Japan only near hot springs. Besides Hakone, it exists at the Nakabusa hot spring in the province of Shinano. It extends as far north as Hokkaidō, where it is found near the hot spring of Noboribetsu.

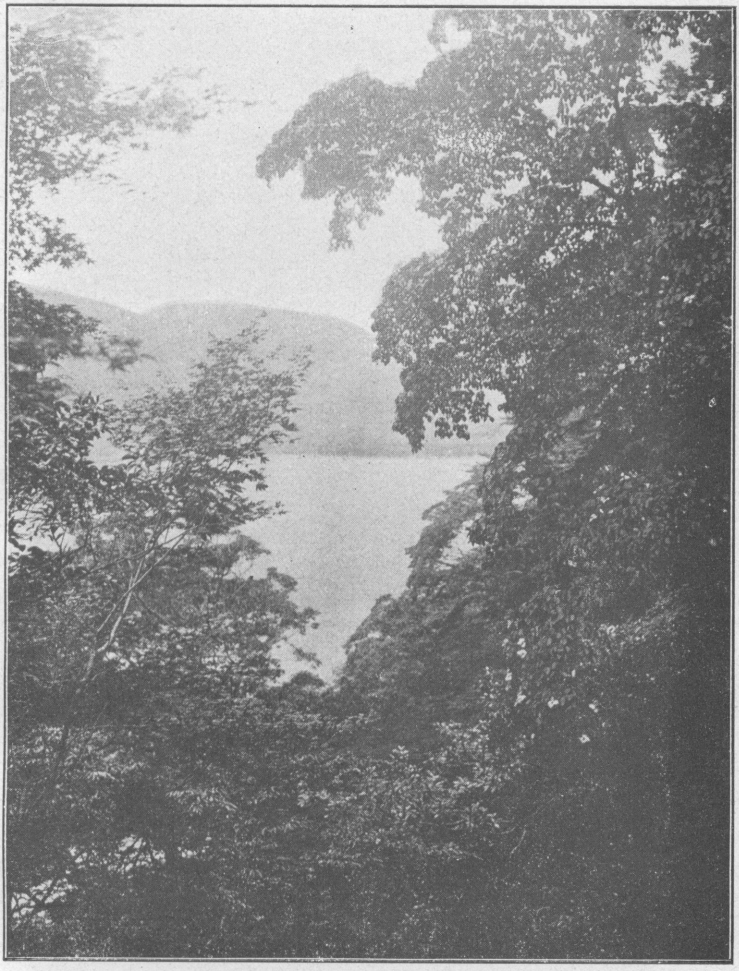


Fig. 14. Lake-side forest near Umijiri; on the right, *Benthamia japonica*; on the left, *Acer pictum*. Phot. B. HAYATA, July 19, 1925.

Here at Ōwakudani, we see a formation of *Sasa*, which is probably not primary, but more likely a growth of secondary origin formed after clearings have been made; for this kind of bamboo, being of a shade-loving nature, is not likely to grow naturally under direct sunshine. *Benthamia japonica* is the principal tree in this forest. Its snow-white blossoms are most magnificent in the summer. To see the flowers from afar, one would imagine snow still lingering in the valleys. Presently, passing near the hot spring of Ubago, we come to the *Miscanthus* formation on the mud flow from Kamiyama and on the *atrio*. Here we see an afforestation of *Cryptomeria* trees; under their shade, grow *Lilium cordifolium*, *Chloranthus serratus*, *Cacalia delphinifolia*, *Pseudopyxis depressa*, *Brylkinia caudata*, and *Athyrium macrocarpum*. Occasionally we pass *Arundinaria* formations with some mixture of *Sasa borealis*. We then reach Umijiri.

3. From Umijiri to Motohakone (Lake-side route).

We come now to the place on the lake-side called Umijiri, whence we proceed through the dense forest beside the lake toward Motohakone (Fig. 14). Here we meet with large trees of *Quercus acuta* and *Quercus crispula*. *Stewartia monadelpha* grows here in abundance. *Illicium anisatum* and *Ilex crenata*, which in other places are usually found as small shrubs, here attain a very large size. The undergrowth of the forest consists mostly of *Sasa borealis* and *Arundinaria Chino*.

In the forest, besides the species already mentioned, the following trees and shrubs are met with:—

Meliosma myriantha,	*Ilex Othera*,
Sapium japonicum,	*Clethra barbinervis*,
Carpinus yedoensis,	*Viburnum Sieboldi*,
Fagus Sieboldi,	*Lindera praecox*,
Abelicea hirta,	*L. umbellata* var. *hypoglauca*,
Stewartia monadelpha,	*Salix gracilistyla*,
Acer pictum,	*Enkianthus campanulatus*,
Magnolia obovata,	*Symplocos crataegoides*.

Among herbs, we find, *Polygonum Thunbergii*, *Lysimachia Fortunei*, *Impatiens Textori*, and *Indigofera pseudo-tinctoria*; among climbers, *Euonymus radicans*, *Schizophragma hydrangeoides* and *Hydrangea*

petiolaris var. *cordifolia;* and among ferns, *Athyrium yokoscense* and *Pteridium aquilinum.*

In the lake, we find several species of water weeds. They are:—

Ranunculus trichophyllus, *Najas major,*
Potomogeton nipponicus, *Hydrilla verticillata* var. *Roxburghii,*
P. Maackianus, *Myriophyllum verticillatum,*
P. perfoliatus, *Vallisneria spiralis,*
P. cristatus, *Chara coronata.*

By the brink of the water, we find *Scirpus lineolatus* FR. et SAV. and *Juncus setchuensis* var. *effusoides* BUCH.

As we pass over the foot of Kamiyama, we come across a bamboo formation on the western slope of Komagatake. Here we see the evergreen shrubs of *Ilex crenata* and *Pieris japonica,* standing out intermittently in an immense formation of *Arundinaria Chino,* like tea trees in a garden. Arriving at the shrine of Gongen, we see nearby a good many plants of *Asteromoea Savatieri, Senecio nikoensis* and *Astilbe chinensis* var. *japonica.* In the shade of the forest of *Cryptomeria* trees, *Pachysandra terminalis* (Fig. 15) almost completely unassociated, grows luxuriantly. The species is rather rare, but whenever it is found, it occurs as here in aggregation. Passing the shrine, we come to the picturesque village of Motohakone. Over the placid waters of the lake at this point, rises Mt. Fuji snow-clad (Fig. 16).

4. Mt. Komagatake.

Though not so high as Kamiyama, Komagataké none the less commands a much finer view. Perhaps for this reason, it is the most popular of the mountains in the Hakone range (Fig. 17). The best route to the top is one diverging at the Futagojaya, just midway between Motohakone and Ashinoyu, from the road we have been following.

At the foot of the mountain, the ground is covered thickly by loam and is rather smooth, and consequently *Miscanthus* formations prevail. In these formations, we meet with:—

Miscanthus sinensis, *Picris hieracioides,*
Arundinella anomala, *Houtuynia cordata,*
Calamagrostis spp., *Angelica polyclada,*
Veronica spuria var. *angustifolia,* *Artemisia vulgaris,*
Hosta japonica, *Aster trinervius,*

Fig. 15. *Pachysandra terminalis* SIEB. et ZUCC. growing in the forest of *Cryptomeria japonica* near the shrine of Gongen at Motohakone. The upper plant with λ-shaped flowers is *Saxifraga sarmentosa* LINN. f. Phot. B. HAYATA, July 17, 1925.

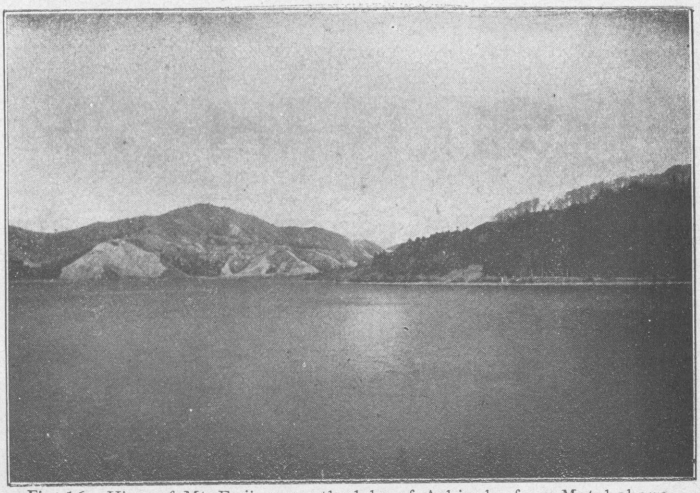


Fig. 16. View of Mt. Fuji across the lake of Ashinoko from Motohakone. In the center rises the snow-clad cone of the volcano; on the right, is the densely wooded promontory of the western foot of Komagataké; to the left of the background, stand the western mountains of the circi; the highest is Mikuniyama (1103 m.). Phot. B. HAYATA, March 27, 1925.

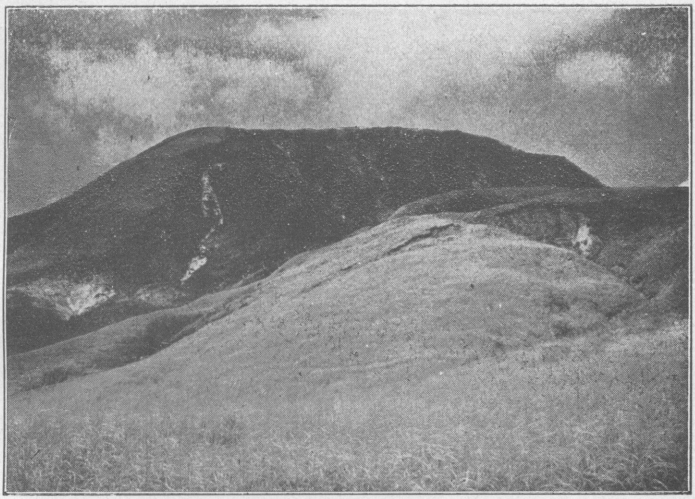


Fig. 17. View of Komagataké, looking west from Yunohanazawa. In the foreground on the loams is a grass formation consisting of *Miscanthus sinensis*. On the northern slope of the mountain, and on lavas, is a forest formation, consisting principally of *Fagus Sieboldi*. Phot. B. HAYATA, March 28, 1925.

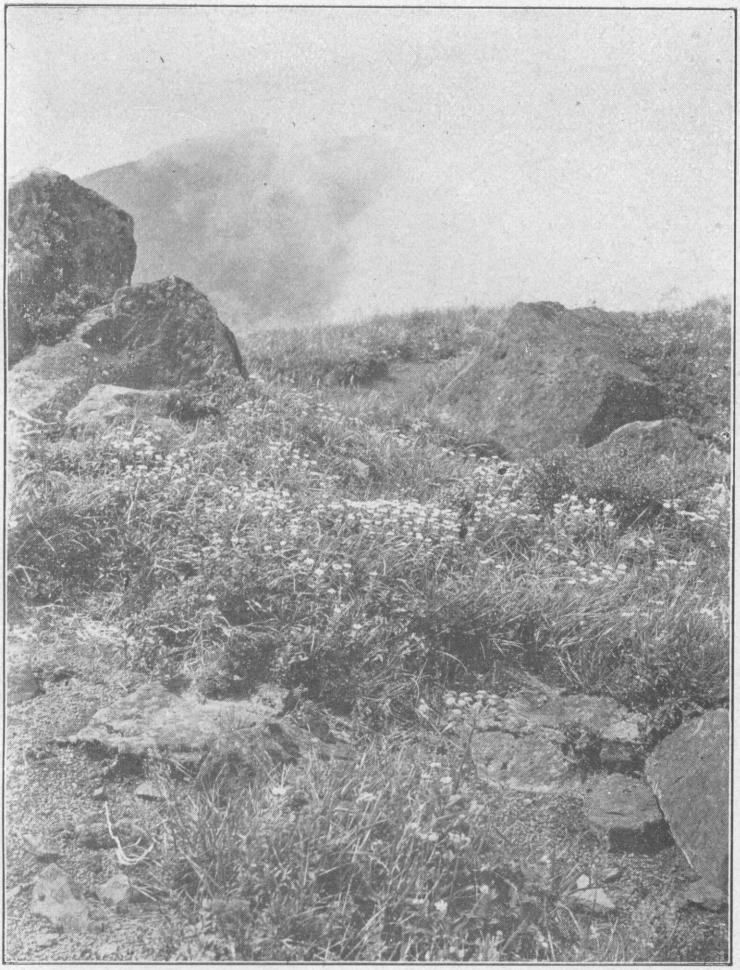


Fig. 18. Summit vegetation of Komágataké: *Aster viscidulus* MAKINO in full bloom. Phot. B. HAYATA, Aug. 28, 1925.

Patrinia scabiosaefolia, *C. spicatum*,
Saussurea Maximowiczii, *Aster viscidulus*,
Eupatoriun Lindleyanum, *Filipendula multijuga*,
Lactuca Thunbergi, *Senecio flammeus*.
Cirsium japonicum, *Hypericum erectum*.

As we proceed, the ground becomes a little ragged, and we find patches of *Arundinaria Chino* here and there. Farther above, at an altitude of 1000 m., the *Arundinaria Chino* gives way to another species, viz., *A. hiratsukensis* and *Heitiku*. Herbaceous patches are met with in which the following species are found:—

Filipendula multijuga, *Pedicularis resupinata*,
Smilax China, *Halenia sibirica*;

among shrubs,

Viburnum Sieboldi, *Acer cissifolium*,
Clethra barbinervis, *Kerria japonica*,
Callicarpa japonica, *Angelica hakonensis*.

Near the top we meet with *Berberis Thunbergii* var. *typica*, *Pieris ovalifolia*, *Spiraea japonica* and *Leucothoe Grayana*. On the top, there is a spacious plain with sandy soil which is consequently covered with a grassy formation, consisting principally of *Calamagrostis Langsdorffii*, with some *Miscanthus Matsumurae* and *C. sachalinensis*. In this formation, we meet with:—

Ligularia japonica var. *clivorum*, *Pseudopyxis heterophylla*,
Cirsium spicatum, *Aster viscidulus*,
Astilbe chinensis var. *japonica*, *Anaphalis* (Fig. 21) *margaritacea*,
Veratrum album, *Euphrasia Iinumai*,
Senecio nemorensis, *Filipendula multijuga*.

Among the grasses are some plants of *Arundinaria hiratsukensis*. On a rocky plot of ground, grow *Primula Reinii*, *Tsusiophyllum Tanakae*, *Orchis Chondradenia*, *Shortia soldanelloides* form. *alpina*, *Patrinia triloba*, *Metanartheciuml eteo-viride* and *Filipendula multijuga* (Fig. 18).

At the western corner of the top, and on the northern slope of the mountain, there exist shrubby formations in which the following species are met with:—

Hydrangea petiolaris var. *cordifolia*, *Pieris japonica*,
Rosa Luciae, *Ligustrum ciliatum*,
R. microphylla, *Deutzia scabra*,
Clethra barbinervis, *Rhododendron quinquefolium*,
Fagus Sieboldi, *R. Kaempferi*,
Rhododendron dilatatum, *Trochodendron aralioides*.
Stewartia monadelpha,

5. The *Cryptomeria* Avenue of Hakone.

There was formerly at the time of the TOKUGAWA Shogunate a beautiful avenue of *Cryptomeria japonica* along the highway to Hakone. It was almost entirely cut down some twenty years ago, and now but a shadow of its former glory remains. Some fine trees, relics of bygone days, are found at the side of the new road between Hakonemachi and Motohakone (Fig. 19.) and still others remain along the old abandoned route at the southern outlet of Hakonemachi (Fig. 20). There on the old route we meet with some interesting ferns, such as *Athyrium mesosorum*, *Polystichum aculeatum* var. *ovato-paleaceum*, *Microlepia Wilfordii* and *Davallia bullata*, and an epiphytic orchid, *Dendrobium moniliforme*. Another species worthy of notice is a climbing plant, *Akebia pentaphylla*, which suggests a hybrid between *A. lobata* and *A. quinata*. Among other climbers, *Euonymus radicans*, *Aristolochia Kaempferi* and *Akebia quinata* and *lobata* are to be found.

6. Mt. Kurakakeyama and the Other Southernmost Members of the Circus Mountains.

Kurakakeyama, one of the southernmost members of the circi, which rises 1004 m. above the level of the sea, is of special interest, as from the top of this mountain we may have an extensive view of the southern side of the compound volcano. The mountain is easily accessible by the route to Yugawara from Hakonemachi. Passing through a formation of *Arundinaria Chino*, with some *A. hiratsukensis*, we meet with :—

Astilbe chinensis,
Anaphalis margaritacea,
Lysimachia Fortunei,
Potentilla cryptotaeniae
Spiraea japonica var. *alpina*,
Deutzia scabra,
Ligularia japonica var. *clivorum*,
Cardiandra alternifolia.

From the top of the mountain, looking to the northeast, we may see the central cones and the surrounding mountains. The circus mountain lying just before our eyes across Byōbuyama and stretching to our right, is Mt. Shirokane. It reaches to Mt. Kurakake where we stand. This side (the side facing us) of Mt. Shirokane is clad with a dense forest.

Far away to our left at the western edge of the lake, stands Mikuniyama (1102 m.), and a little nearer us is the pass of Yamabushi (1034 m.), which extends to Mt. Kurakake. Between these circus

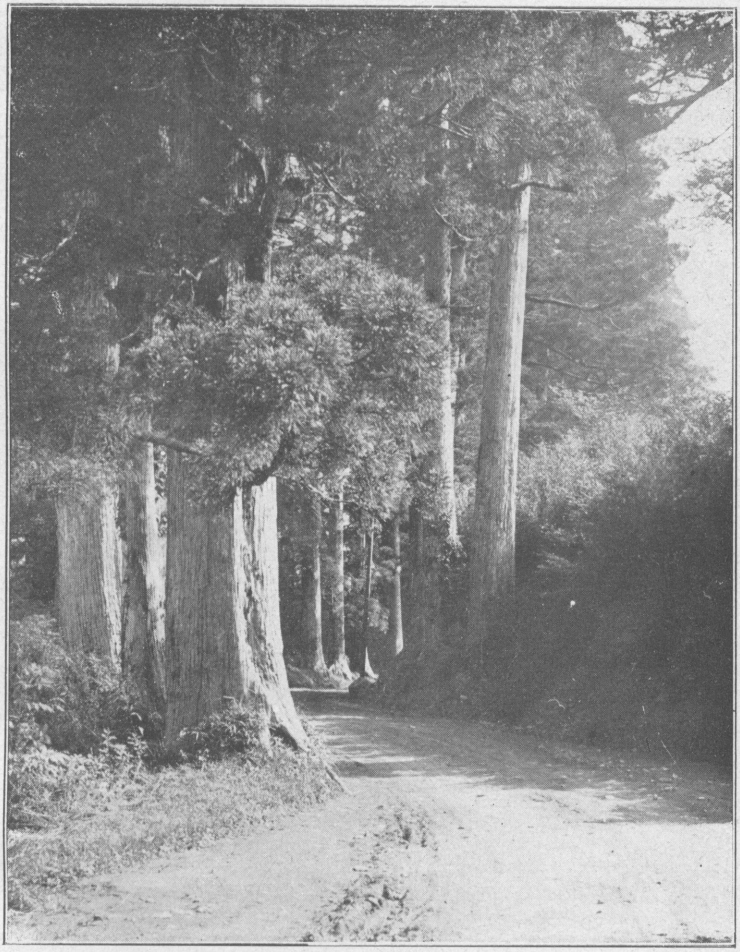


Fig. 19. Ancient trees, relics of the grand *Cryptomeria* avenue of former days, on the highway between Hakonemachi and Motohakone. The dwarf bamboo on both sides of the road is *Arundinaria Chino* MAK. Phot. B. HAYATA, July 18, 1925.

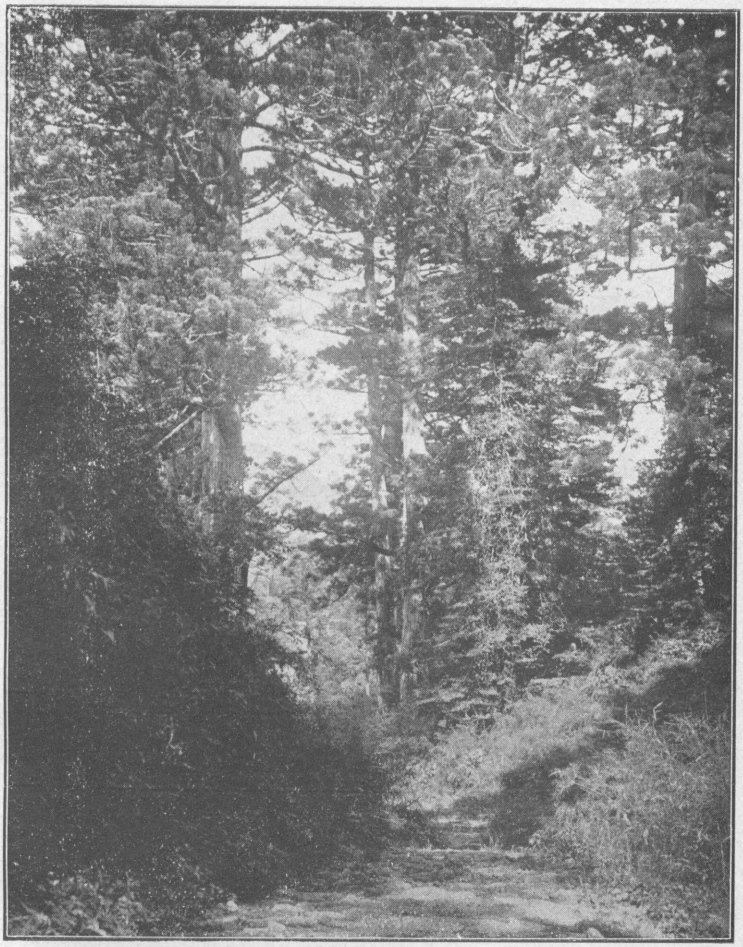


Fig. 20. The *Cryptomeria* avenue in ruins on the abandoned road at the southern outlet of Hakonemachi. The road paved with rounded stones and bordered with old *Cryptomeria* reminds us of bygone days in the age of the TOKUGAWA Shōgunate. In the foreground, on the right and left, are clumps of *Arundinaria Chino* and on the right is some *Euonymus radicans*, a wood climbing plant. Through the trees appears the steep slope of Byōbuyama. Phot. B. HAYATA, July 18, 1925.

mountains and lying just under our eyes on the left, is Mt. Magosuke (956 m.), which is of a tuffite formation. At a short distance to the left of Mt. Magosuke, we see Byōbuyama (948 m.), one of the central cones; a little farther away and across the same cone, we see a mountain with two crests, the upper (1090 m.) called Kamiyama and the lower (1064 m.), Shimoyama; together, they are known as Futagoyama. On one side of these cones where the ground is rocky and more or less consolidated so as to afford a footing for plants, there is found some shrubbery, while on the other side where the ground is covered with sands or ashes and is movable, or as yet not firm enough, there are to be seen only grass formations or else no indication at all of vegetable growth. To the left of Futagoyama and far to the north, stands Komagatake (1350 m.). The southern flank of Mt. Kurakake is for the most part covered by a dense forest in which we meet with:—

Alnus firma,
Lindera praecox,
Symplocos crataegoides,
Pieris japonica,
Philadelphus Satsumi,
Acanthopanax Sieboldianum,
Benthamia japonica,
Rosa Luciae,
Viburnum erosum,
Enkianthus campanulatus,
Hydrangea paniculata,
Acanthopanax spinosum,
Diervilla floribunda var. *versicolor*,
Prunus incisa,
Ligustrum ciliatum,
Ilex crenata,
Rosa microphylla,
Viburnum dilatatum.

On the top, the ground is generally covered with loams and we find a grass formation consisting chiefly of *Calamagrostis Langsdorffii*.

Proceeding as far south as Yugarawa, we find plants which are more or less of a sub-tropical nature. They are:—

Camellia japonica,
Prunus spinulosa,
Clerodendron trichotomum,
Euptelaea polyandra,
Ardisia crispa,
Pseudogardnera nutans,
Polypodium nipponicum,
Gleichenia linearis,
Mallotus japonicus,
Hydrangea virens,
Eurya ochnacea,
Caesalpinia sepiaria,
Stauntonia hexaphylla,
Illicium anisatum,
Marsdenia tomentosa,
Skimmia japonica,
Gleichenia glauca,
Euscaphis japonica,
Trachelospermum jasminoides,

—all representative of the flora found in the warmer regions of Japan.

Now returning to Hakonemachi and again starting for the southernmost members of the circi, we proceed to Mt. Umidaira (941 m.). From the top, as far as we can see toward the southern side, is a wonderful stretch of grass formation consisting mainly of *Calamagrostis* in its upper and of *Miscanthus* in its lower half, extending mile after mile nearly to the foot of the compound volcano.

7. The Ashigara Pass.

The pass traverses the mountain ridge nearly midway between Kintokiyama and Yuguradake. Passing along the route which extends from east to west, that is, from Jizōdō to Takenoshita, we find the ground on both sides of the pass covered entirely by volcanic sand and lapilli which are said to have been deposited there some two hundred years ago as a result of the eruption of a parasitic cone of Mt. Fuji, called Hoyé. The pass itself and its vicinity are occupied by grass formations consisting for the most part of *Miscanthus*, *Arundinella* and *Calamagrostis*. The total absence of the dwarf bamboo formations (except a very small quantity of *Sasa borealis* which grows in the shade of the shrubbery) is worthy of notice. Another remarkable feature is the predominance of *Alnus incana* var. *sibirica* among the shrubbery in the valleys. The striking resemblance of the vegetation of the Ashigara pass to that of some regions on the eastern side of Mt. Fuji is strong testimony in favour of the view that the vegetation here is controlled chiefly by the edaphic factor. As I traversed the pass from the eastern side, I saw on my right Yaguradake (867 m.), rising abruptly from the bottom of the valley. At the foot are a few trees of *Abelicea hirta*. Near the top, I found some scattered specimens of *Pinus Thunbergii* which are, in all probability, though unusual in mountain regions, a quite natural growth. To see this black pine, which is usually to be found near the shore, at such an altitude as in this case is no common occurrence. Presumably the seeds were distributed on the summit from trees which form an avenue on the western side of the pass. The avenue consists of a number of old pines standing along an abandoned road which up to nearly two hundred years ago was a busy highway. Nothing can be more touching than to see the pine grove still surviving the road, as if to tell the history of the ruin of what was once flourishing but is now altogether neglected.

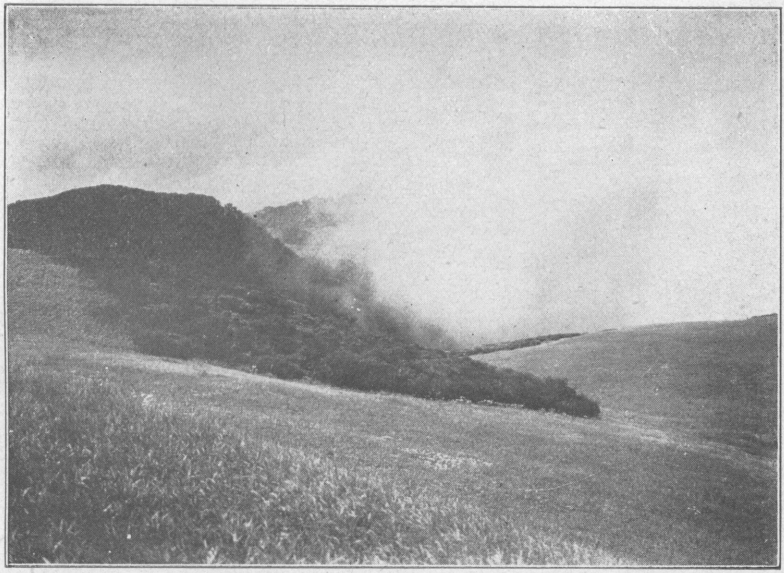


Fig. 21. *Anaphalis margaritacea* in the alpine meadows on the top of Komagataké. Phot. B. HAYATA, Aug. 23, 1925.

VII. ABSENCE OF CONIFEROUS FORMATIONS.

The nearly total absence of coniferous formations in our mountains is certainly one of the peculiar features of the vegetation of Hakone. This fact is all the more striking when we consider that in adjacent regions, such as the Amagi mountains to the south, and Mt. Fuji to the north, there exists many a magnificent formation of conifers. A partial clue to this puzzling problem may be found when we compare the geological formations in our mountains with those in the neighbouring regions. I shall not enter into details in this discussion, yet I may point out that the lava streams called "Marubi" which are found in close relation with the coniferous formations on Mt. Fuji and in other regions are totally absent in our mountains. As far as my knowledge goes, there exist only a few scattered natural stands of *Abies firma* in one locality near Hirogawara, and also at another place called Ōmomiso near Yugawara. A few trees of *Pinus densiflora* are found on the southern side of Mt. Tōnomine.

VIII. AUTUMNAL COLORATION.

My readers, coming to Hakone in the fall of the year, will perhaps be anxious to know what plants take part in the beautiful autumnal coloration. One may imagine that maples are the greatest contributors. But I think this may not be the case. I have never been in Hakone in the autumn, and therefore I have had no opportunity to solve the question by direct experience; yet I may say that as far as I can judge from my experience in other places, maples are behind other trees, both in their quantity and in their coloration. I shall here give a list of trees which may more or less contribute to the autumnal tints in the Hakone region, and leave my readers to answer the problem as to which is the most important of all the plants exhibiting beautiful foliage at this season of the year.

1. Those plants the foliage of which turns a brilliant scarlet in the fall are:—

Fraxinus longicuspis,
Rhus Toxicodendron var. *vulgaris*,
Rhus trichocarpa,
Rhus japonica,
Acer japonicum,
A. argutum,
A. palmatum,
A. crataegifolium,
A. Sieboldianum,
A. cissifolium,
A. nikoense,
A. micranthum,

Sorbus japonica,
Euonynus oxyphyllus,
E. alata,
E. alata var. *striata*,
Photinia villosa,
Viburnum dilatatum,
Benthamia japonica,
Rhododendron dilatatum,
R. quinquefolium.

2. Those plants the foliage of which presents the most variegated coloration ranging from yellow and brown to red and scarlet are:—

Stephanandra incisa,
Vitis Coignetiae,
V. flexuosa,
Clethra barbinervis,
Cornus controversa,
Viburnum furcatum,
V. phlebotrichum,
V. urceolatum,
V. Wrightii,
Aralia chinensis,
Rhododendron sinense,
Berberis Sieboldi,
Vaccinium ovalifolium,
V. hirtum var. *Smallii*,
V. ciliatum,
Tripetaleia paniculata,
Acer rufinerve.
Acer pictum,
A. carpinifolium,
A. distylum,
Spiraea salicifolia,
Euonymus macroptera,
Ligustrum Ibota,
Prunus donarium,
Quercus crispula,
Akebia lobata and *quinata*,
Linnaea spathulata,
Pieris ovalifolia,
Stachyurus praecox,
Carpinus laxiflora,
Abelicea hirta,
Rhododendron Kaempferi,
Cormus Tschonoskii.

IX. GENERAL ASPECTS OF THE FLORA.

A. General Remarks.

The flora of Hakone, as far as vascular plants are concerned, comprises 1181 species, belonging to 126 families. It contains mixed elements of the floras of northern and southern regions, with some species which are all but peculiar to this region. The species belonging to the latter group are as follows:—

Polypodium Okuboi YATABE,
Leucothoe Keiskei MIQ.,
Hakonechloa macra MAKINO,
Primula Reinii FRANCH. et SAV.

Pachysandra terminalis SIEB. et ZUCC.
Tsusiophyllum Tanakae MAXIM.
Tanakaea radicans FRANCH. et SAV.

The most interesting feature of the flora under consideration is the inclusion in it of plants usually found in much warmer regions. The species belonging to this group are as follows:—

Lycopodium cernuum LINN.
L. Cryptomerinum MAXIM.
Prunus spinulosa SIEB. et ZUCC.
P. macrophylla SIEB. et ZUCC.
Pteris longipinnula WALL.
Polypodium ensatum THUNB.
P. involutum METT.
P. nipponicum METT.
P. Loxogramme METT.
Osmunda lancea THUNB.
Reineckia carnea KUNTH.
Bulbophyllum inconspicuum MAXIM.
Chloranthus glaber MAKINO.
Myrica rubra SIEB. et ZUCC.
Ficus foveolata WALL.
F. pumila LINN.
Debregeasia edulis WEDD.
Loranthus Yadoriki SIEB.
Trochodendron aralioides SEIB. et ZUCC.
Prunus macrophylla SIEB. et ZUCC.
P. spinulosa SIEB. et ZUCC.
Securinega fluggeoides MUELL. ARG.
Maesa japonica MORITZ.
Ardisia crispa DC.
Pseudogardnera nutans REICHENB.
Conandron ramondioides SIEB. et ZUCC.
Rhynchospermum verticillatum REINW.
Conyza japonica LESS.

There follows a list of plants commonly found in the Hakone mountains and occassionally mentioned in this paper, including those which are of special interest and which may be said collectively to give its peculiar nature to the flora under consideration. The names of families and the numbers of species of each family occurring are also given in the list, so as to include the total number of plants constituting the flora of the region.

b. An abridged list of plants found in Hakone.

Characeae : Chara coronata A. Br.
Sphagnaceae : Sphagnum cymbifolium Warnst.
Hymenophyllaceae : 4 species, all common.
Polypodiaceae : 81 species, including

Adiantum monochlamys Eat.	Onoclea sensibilis Linn.
A. pedatum Linn.	Polypodium ensatum Thunb.
Athyrium acrostichoides Sw.	P. involutum Mett.
A. Filix foemina Roth.	P. Loxogramme Mett.
A. macrocarpum Bedd.	P. nipponicum Mett.
A. mesosorum Mak.	P. Okuboi Yatabe.
A. yokoscense Christ.	P. senanense Maxim.
Blechnum nipponicum Mak.	Polystichum aculeatum Schott. var. ovatopaleaceum Kodama.
Davallia bullata Wall.	P. Standishii C. Ch.
Dryopteris Dickinsii C. Ch.	P. tsussimense Hooker.
D. hirtipes O. Kuntz.	Pteridium aquilinum Kuhn.
D. Phegopteris (L.) C. Ch.	Pteris longipinnula Wall.
D. ochtodes C. Chr.	P. semipinnata L. var. dispar Bak.
D. subtripinnata (Miq.) O. Ktze.	Woodsia japonica Mak.
Gymnogramme Makinoi Maxim.	W. sinuata H. Chr.
Microlepia marginata Hance.	and others.
M. Wifordii Moore.	
Gleicheniaceae : 2 species,	
Gleichenia glauca Hooker.	G. linearis Clark.

Schizaeaceae : 1 species.
Osmundaceae : 2 species, including Osmunda lancea Thunb.
Ophioglossaceae : 4 species, including
Botrychium strictum Unders and others.
Equisetaceae : 3 species, including
Equisetum hiemale Linn. and others.
Lycopodiaceae : 6 species, including
Lycopodium Cryptomerinum Maxim.
L. cernuum Linn. and others.
Selaginellaceae : 4 species.
Taxaceae : 2 species, including Torreya nucifera S. et Z.
Pinaceae : 2 species.
Sparganiaceae : 2 species,
Sparganium longifolium Turcz and S. simplex Huds.

Potamogetonaceae : 4 species,
Potamogeton cristatus LINN. P. nipponicus MAK.
P. Maackianus BENN. P. perfoliatus LINN.

Najadaceae : 1 species, Najas major ALL.

Alismataceae : 2 species, including
Alisma Plantago var. angustifolium KUNTH.

Hydrocharitaceae : 2 species,
Hydrilla verticillata ROYL. var. Roxburghii CASP. and
Vallineria spiralis LINN.

Gramineae : 84 species, including
Agrostis tenuiflora STEUD.
Andropogon micranthus KUNTH.
Arrhenatherum avenaceum BEAUV.
Arundinaria Chino MAK.
Brylkinia caudata FR. SCHM.
Calamagrostis sachalinensis FR. SCHM.
C. Epigeios ROTH.
Coelachne pulchella R. BR.
Dactylis glomerata LINN.
Diplachne serotina LINK. var. aristata HACK.
Hokonechloa macra MAK.
Holcus lanatus LINN.
Imperata arundinacea CYR.
Isachne australis R. BR.
Lolium perenne LINN.
Miscanthus sacchariflorus HACK.
M. sinensis ANDERS.
Muehlenbergia japonica STEUD. var. hakonensis HACK.
Phleum pratense LINN.
Phragmites longivalvis STEUD.
Ph. prostratus MAK.
Sasa borealis MAK. et SHIB.
S. nipponica MAK. et SHIB.
Zoysia pungens WILLD. var. japonica HACK.
Spodiopogon sibiricus and others (Fig. 5).

Cyperaceae : 80 species, including
Bulbostylis barbata KUNTH.
Carex Onoei FR. et SAV.
Cyperus hakonensis FR. et SAV.
Eleocharis tetraquetra NEES.
Fimbristylis longispica STEUD.
F. subbispicata NEES et MEY.
Scirpus Cyperinus KUNTH. var. concolor MAK.
Scirpus lineolatus FR. et SAV.
S. Mitsukurianus MAK.
Scleria tessellata WILLD.
and others.

Araceae : 5 species, including
Pinellia ternata BREITENB. and others.

Eriocaulaceae : 4 species,
Eriocaulon alpestre HOOK. f. et THOMS.
E. nipponicum MAXIM.
E. Sieboldianum STEUD. and E. shikokianum MAXIM.

Commelinaceae : 3 species, including
Aneilema Keisak HASSK. and others.

Juncaceae : 10 species, including
Juncus setchuensis BUCH. var. effusoides BUCH.

Liliaceae : 38 species, including
Lilium auratum LINDL.
L. cordifolium THUNB.
Metanarthecium luteo-viride MAXIM.
Reineckia carnea KUNTH.
Smilax China L.
Tofieldia gracilis FR. et SAV.
T. nutans WILLD.
Veratrum album LINN. and others.

Amaryllidaceae : 2 species.

Dioscoreaceae : 5 species.

Iridaceae : 4 species, including
Iris gracilipes A. GRAY. I. laevigata FISCH.
Iris siberica L. var. orientalis MAXIM.

Orchidaceae : 30 species, including

Bulbophyllum inconspicuum MAKINO.
Calypso bulbosa REICHB. f.
Cremastra appendiculata MAK.
Cymbidium virens LINDL.
Cypripedium macranthum SW.
Dendrobium moniliforme SW.
Epipactis Thunbergii A. GRAY.
Galeola septentrionalis REICHB. f.
Goodyera repens R. BR.
G. Schlechtendaliana REICHB. f.
Gymnadenia cyclochila KORS.
Oberonia japonica MAK.
Myrmechis gracilis BLUME.
Orchis chondradenia MAK.
Platanthera Inumae MAK.
P. mandarinorum REICHB. f.
P. hologlottis MAXIM.
P. rupestris SCHLECHT.
P. usuriensis MAXIM.
P. Yatabei MAXIM.
Pogonia japonica REICHB. f.
P. japonica REICHB. f. var minor MAK.
Sarcochilus japonicus MIQ.
Spiranthes australis LINDL.
and others.

Saururaceae : 1 species, Houttuynia cordata THUNB.

Piperaceae : 1 species, Piper Futokadzura SIEB.

Chloranthaceae : 3 species, including
Chloranthus glaber MAK. and others.

Juglandaceae : 1 species.

Myricaceae : 1 species, Myrica rubra SIEB. et ZUCC.

Salicaceae : 11 species, including
Salix gracilistyla MIQ. and others.

Betulaceae : 8 species, including
Alnus firma S. et Z. Carpinus yedoensis MAXIM.
Carpinus laxiflora BLUME. and others.

Fagaceae : 13 species, including
Fagus japonica MAXIM. Quercus crispula BLUME.
F. Sieboldi (MAXIM). Q. sessilifolia MAXIM.
Quercus acuta THUNB.

Ulmaceae : 3 species, including
Abelicea hirta SCHUM. and others.

Moraceae : 9 species, including
Ficus foveolata WALL. F. pumila LINN. and others.

Urticaceae : 15 species, including Debregeasia edulis WEDD.

Loranthaceae : 4 species, including Loranthus Yadoriki SIEB.

Santalaceae : 2 species.

Aristolochiaceae : 5 species.

Polygonaceae : 29 species, including
Polygonum Thunbergii S. et Z. Rumex conglomeratus MURR.
Reynoutria japonica HOUTT. R. crispus LINN. and others.

Chenopodiaceae : 2 species.

Amarantaceae : 3 species.

Cynocrambaceae : 1 species, Cynocrambe japonica MAK.

Aizoaceae : 1 species.

Portulacaceae : 1 species.

Caryophyllaceae : 14 species.

Magnoliaceae : 6 species, including
Kadsura japonica DUNAL. M. parviflora SIEB. et ZUCC.
Magnolia obovata THUNB. Schizandra nigra MAXIM, and others.

Euptelaeaceae : 1 species, Euptelaea polyandra SIEB. et ZUCC.

Trochodendraceae : 1 species, Trochodendron aralioides SIEB. et ZUCC.

Ranunculaceae : 28 species, including
Anemone altaica FISCH.
Clematis montana BUCH. var. Williamsii O. KTZE.
Coptis quinquefolia MIQ.
Ranunculus trichophyllus CHOIX.
Thalictrum actaefolium S. et Z. and others.

Lardizabaraceae : 4 species, including
Akebia lobata DECNE. Akebia pentaphylla MAK.
A. quinata DECNE. Stauntonia hexaphylla DECNE.

Berberidaceae : 3 species, including
Berberis Sieboldii MIQ.
B. Thunbergii DC. var. typica REGEL.

Menispermaceae : 2 species.

Lauraceae : 8 species, including
Cinnamomum pedunculatum NEES.
Lindera glauca BLUME.
Lindera umbellata THUNB. var. hypoglauca MAK.
Lindera praecox BLUME and others.

Papaveraceae : 6 species.

Cruciferae : 12 species.

Droseraceae : 1 species, Drosera rotundifolia LINN.

Crassulaceae : 6 species, including
Sedum hakonense MAK. and others.

Saxifragaceae : 31 species, including
Astilbe chinensis MAXIM. var. japonica FR. et SAV.
Cardiandra alternifolia SIEB. et ZUCC.
Deutzia scabra THUNB.
Hydrangea hirta SIEB. et ZUCC.
H. opuloides K. KOCH. var. pubescens SCHNEID.
H. paniculata SIEB.
H. petiolaris S. et Z. var. cordifolia MAXIM.
Parnassia foliosa HOOK. f. et THOMS.
P. palustris LINN.
Philadelphus Satsumi SIEB.
Schizophragma hydrangeoides SIEB. et ZUCC.
Tanakaea radicans SIEB. et ZUCC. and others.

Hamamelidaceae : 1 species.

Rosaceae : 47 species, including
Cormus Tschonoskii KOIDZ.
Filipendula multijuga MAXIM.
Kerria japonica DC.
Prunus crassipes KOIDZ.
P. donarium SIEB.
P. incisa THUNB.
P. macrophylla SIEB. et ZUCC.
P. spinulosa SIEB. et ZUCC.
Photinia villosa DC.
Potentilla cryptotaeniae MAXIM.
Rosa fujisanensis MAK.
Rosa Luciae FRANCH. et ROCH.
R. microphylla ROXB.
Rubus Lambertianus SER.
Subsp. hakonensis FOCK.
Spiraea japonica L. f.
S. japonica L. f. var. alpina MAXIM.
Spiraea salicifolia L.
Stephanandra incisa ZABEL.
S. Tanakae FR. et SAV.
and others.

Leguminosae : 40 species, including

Cæsalpinia sepiaria ROXB.
Indigofera pseudo-tinctoria MATSUM.
Lotus corniculatus LINN.
Medicago sativa LINN.
Trifolium pratense LINN.
Trifolium repens LINN.
and others.

Geraniaceae : 2 species.

Oxalidaceae : 2 species.

Linaceae : 1 species.

Rutaceae : 7 species, including

Phellodendron sachalinense SARG. and others.

Simarubaceae : 1 species.

Polygalaceae : 1 species.

Euphorbiaceae : 9 species, including

Daphniphyllum glaucescens BLUME.
Sapium japonicum PAX et HOFF.
Securinega fluggeoides MUELL. ARG. and others.

Coriariaceae : 1 species.

Buxaceae : 1 species, Pachysandra terminalis SIEB. et ZUCC.

Anacardiaceae : 5 species, including

Rhus javanica L. Rh. Toxicodendron L. var. vulgaris PURSH.
Rh. sylvestris SIEB. et ZUCC. Rh. trichocarpa MIQ. and others.

Aquifoliaceae : 3 species, including

Ilex crenata THUNB. I. Othera SPR.

Celastraceae : 7 species, including

Euonymus alata SIEB.
E. alata SIEB. var. striata MAK.
Euonymus oxyphylla MIQ.
E. macroptera RUPR. and others.

Staphyleaceae : 2 species.

Aceraceae : 12 species, including

Acer argutum MAXIM.
A. cissifolium KOCH.
A. crataegifolium SIEB. et ZUCC.
A. distylum SIEB. et ZUCC.
A. japonicum THUNB.
A. micranthum S. et Z.
A. nikoense MAXIM.
A. palmatum THUNB.
A. pictum THUNB.
A. rufinerve SIEB. et ZUCC.
A. Sieboldianum MIQ.
A. spicatum LAM.
var. ukurunduense MAXIM.

Balsaminaceae : 2 species, including Impatiens Textori MIQ.

Sabiaceae : 2 species, including

Meliosma myriantha SIEB. et ZUCC.

Rhamnaceae : 5 species, including

Hovenia dulcis THUNB.
Rhamnus davurica PALL. var. nipponica MAK.
Rh. japonica MAXIM. var. decipiens MAXIM. and others.

Vitaceae : 5 species, including
Vitis Coignetiae PULLIAT.
Vitis flexuosa THUNB. and others.

Tiliaceae : 2 species.

Actinidiaceae : 2 species.

Camelliaceae : 5 species, including
Eurya ochnacea SZYSE.
Stewartia monadelpha (S. et Z.) and others.

Stachyuraceae : 1 species, Stachyurus praecox SIEB. et ZUCC.

Guttiferae : 8 species, including Hypericum crassifolium NAK.
H. hakonensis FR. et SAV. H. Vanioti LEV. and others.

Violaceae : 21 species.

Thymelaeaceae : 3 species, including
Wikstroemia Gampi MAXIM. W. pauciflora FR. et SAV.

Elaeagnaceae : 7 species, including
Elaeagnus Matsuoana MAK. E. montana MAK. and others.

Lythraceae : 3 species, including Lythrum Salicaria LINN.
subvar. genuina KOHNE and others.

Oenotheraceae : 5 species.

Halorrhagidaceae : 3 species, including
Myriophyllum verticillatum LINN.

Araliaceae : 10 species, including
Aralia chinensis LINN.
Acanthopanax japonicum FR. et SAV.
A. Sieboldianum MAK.

Umbelliferae : 24 species, including
Angelica florenti FR. et SAV.
A. hakonensis MAXIM.
A. polyclada FRANCH.
Peucedanum terebintaceum FISCH.
Chamaele decumbens MAK. var. japonica MAK. and others.

Cornaceae : 6 species, including
Benthamia japonica SIEB. et ZUCC.
Cornus brachypoda C. A. MAY.
C. controversa HEMSL. and others.

Clethraceae : 1 species, Clethra barbinervis SIEB. et ZUCC.

Pyrolaceae : 3 species.

Ericaceae : 16 species, including
Azaleastrum semibarbatum MAK. Pieris ovalifolia DON.
Enkianthus campanulatus NICHOLS. Rhododendron dilatatum MIQ.
Leucothoe Grayana MAXIM. Rh. Kaempferi PLANCH.
L. Keiskei MIQ. Rh. quinquefolium BISS. et MOORE.

Rh. sinense SWEET.
Tripetaleia paniculata SIEB. et ZUCC.
Tsusiophyllum Tanakae MAXIM.
Vaccinium ciliatum THUNB.
V. hirtum THUNB.
V. hirtum THUNB. var. Smallii MAXIM.
V. ovalifolium SMITH. and others.

Diapensiaceae : 1 species, Shortia soldanelloides MAK.
form. typica and alpina MAK.

Myrsinaceae : 3 species, including
Ardisia crispa DC. Maesa japonica MORITZ. var. latifolia MIQ.

Primulaceae : 6 species, including
Lysimachia clethroides DUBY. Lysimachia vulgaris LINN.
L. Fortunei MAXIM. Primula Reinii FR. et SAV. and others.

Ebenaceae : 2 species.

Symplocaceae : 1 species, Symplocos crataegoides BUCH.

Styraceae : 2 species, including Styrax japonica SIEB. et ZUCC.

Oleaceae : 6 species, including
Fraxinus longicuspis SIEB. et ZUCC.
Ligustrum ciliatum, L. Ibota SIEB. and others.

Loganiaceae : 2 species, including
Pseudogardnera nutans REICHB.

Gentianaceae : 7 species, including
Halenia sibirica BORK. and others.

Asclepiadaceae : 9 species, including
Cynanchum atratum BUNGE. C. japonicum HEMSL.
C. grandiflorum HEMSL. Marsdenia tomentosa MORR.

Convolvulaceae : 4 species.

Borraginaceae : 7 species.

Verbenaceae : 6 species, including
Callicarpa japonica THUNB.
Clerodendron trichotomum THUNB. and others.

Labiatae : 39 species, including
Lamium humile MAXIM.
Lophanthus rugosus FISCH. et MEY.
Lycopus Maackianus MAK. var. ramosissimus MAK.
Lycopus virginicus L. and its variety parviflorus MAK.
Scutellaria dependens MAXIM. and others.

Solanaceae : 7 species.

Scrophulariaceae : 16 species, including
Euphrasia Iinumai TAKEDA.
Pedicularis resupinata LINN.
Veronica spuria L. var. angustifolia BENTH. and others.

Orobanchaceae : 3 species, including
Lathraea japonica MIQ. and others.

Gesneraceae : 2 species, including
Conandron ramondioides SIEB. et ZUCC.

Acanthaceae : 2 species, including Dicliptera japonica MAK.

Plantaginaceae : 3 species, including
Plantago lanceolata LINN. and others.

Rubiaceae : 18 species, including
Galium vernum LINN. var. typicum MAXIM.
Pseudopyxis depresea MIQ.
P. heterophylla MAXIM.
Rubia chinensis REGEL. and others.

Caprifoliaceae : 14 species, including
Diervilla floribunda SIEB. et ZUCC. var. versicolora MAK.
Linnaea spathulata GRAEBN.
Viburnum dilatatum THUNB.
V. furcatum BLUME.
V. phlebotrichum S. et Z.
V. Sieboldi MIQ.
V. urceolatum S. et Z.
V. Wrightii MIQ.
and others.

Valerianaceae : 4 species, including
Patrinia scabiosaefolia LINK. P. triloba MATSUM. and others.

Dipsacaceae : 2 species.

Cucurbitaceae : 5 species.

Campanulaceae : 9 species.

Compositae : 106 species, including
Anaphalis margaritacea BENTH et HOOK. (Fig. 21)
Artemisia vulgaris LINN. var. vulgatissima BESS.
Aster dimorphophyllus FR. et SAV.
Aster Maackii REGEL.
A. viscidulus MAK. (Figs. 8 and 18).
Asteromoea Savatieri MAK.
Cacalia delphinifolia S. et Z.
Cirsium japonicum DC.
C. Hilgendorfii MAK.
C. spicatum (MAX.) MATSUM.
Conyza japonica LESS.
Lactuca dentata MAK.
var. Thunbergii MAK.
Ligularia japonica LESS.
var. Clivorum MAK.
Li. sibirica CASS.
Perenanthes acerifolia MATSUM.
Rhynchospermum verticillatum REINW.
Saussurea japonica DC.
Senecio nemorensis LINN.
Senecio nikoensis MIQ. and others.

NOTES ON THE ZOOLOGY OF THE HAKONÉ DISTRICT

By Tokio Kaburaki

Hakoné is the name given to an extensive mountainous district forming the neck of the Idzu peninsula which divides Sagami Bay from Suruga Bay. At an altitude of 725 m. lies *Ashi-no-ko*, or Hakoné Lake, which is about 177 km. in circumference. It is almost completely surrounded by verdure-covered mountains, which give to its immediate scenery a charming variety, dominated by Mt. Fuji in the distance. In feudal times the Hakoné mountains constituted a natural barrier between the eastern and western provinces, and all travellers using the Tōkaidō route between the two capitals, Tokyo and Kyoto, had to take the road leading from the foot of the mountain up steep gradients and through rocky defiles, until they reached the guard-house at the top, where they had to submit to strict examination. This old road still remains, and the site of the historic guard-house is now marked by a pine-tree and remains of the stone barrier on each side of the road between the villages of Hakoné and Moto-Hakoné, near the lake. Hakoné's chief distinction lies in its hot springs at various places in the mountains, and in its scenic charms which grace it all the year round.

Dwelling in this district are several forms of animal life, which receive less attention than the plant forms which are of more specific interest. In feudal times the district included, as might be expected, a heavily timbered belt quite favourable to the life of some wild mammals, like the bear (*Ursus torquatus japonicus*) and the deer (*Cervus nippon*), but they have now been driven to other parts of the country.

At present, if rats and mice are left out of consideration, the commonest mammal is the hare (*Lepus brachyurus brachyurus*), whose coat is a permanent gray the year round. Of frequent occurrence is the mole-shrew (*Urotrichus talpoides hondonis*) which lives underground in burrows which it excavates. Dwelling in woods and thickets are the squirrel (*Sciurus lis*) and the large flying squirrel (*Petaurista leucogenys*). The latter, apparently unlike the former which moves

amongst the branches in the daytime, remains secure in the hollows of trees by day. Hiding during the day in caves and clefts are a number of horse-shoe bats of the species *Rhinolophus nippon*, which is distributed over Japan proper, Korea, Manchuria, and South China. Though there are other forms found in this district, they are not likely to be met with. They are the dormouse (*Glirulus japonicus*), the monkey (*Macaca fuscata*), the "tanuki" (*Nyctereutes viverrinus*), the fox (*Vulpes japonicus*), the badger (*Meles anakuma*), the boar (*Sus leucomystax*), and others, which are all limited in distribution to Japan proper.

Owing to their common occurrence about the haunts of man and to their attractive appearance and songs, the birds are very much in evidence. On all sides we can see a number of interesting forms which seem to find the region favourable. To encourage them and thereby increase their numbers the Hakoné district as a whole is soon to be set apart as a game sanctuary.

The great glory of the mountain thickets are the two cuckoos, *Cuculus canorus telephonus* and *C. poliocephalus poliocephalus*, which have hitherto been greatly celebrated in our poems on account of their melancholy notes. The former is much larger than the latter, and has a wider range, being found all over this country and indeed over nearly all the Old World. In the warmer season it breeds chiefly in northern districts, where it remains until October, when it migrates towards the south. The little cuckoo is of a comparatively narrower range and is not known in the Kuriles or Saghalien. Nor does it breed south of the Himalayas. In winter it migrates as far as India, Java, Borneo, and Africa. As is well known, the eggs of these species are always laid in the nests of other birds, which rear the intruder and feed it until it leaves the country. The usual foster-parents are the shrikes, the blue flycatcher, *Acrocephalus arundinaceus orientalis*, *Emberiza cioides ciopsis*, and others. As the cuckoos feed on various insects, especially caterpillars noxious to crops and forests, they are of some economic importance.

The best songsters are two flycatchers, *Terpsiphone atrocaudata atrocaudata* and *Cyanoptila cyanomelana cyanomelana*. The latter has a much wider range than the former, and is found from the Kuriles in the north to Formosa in the south. The first paradise flycatcher is called "Sankocho" in Japanese on account of its notes, "Tsuki-hoshi-hi", literally "Moon-Star-Sun". The male is easily distin-

guished by his long tail. The second, the blue flycatcher has its home in the deep forest, but oftentimes comes near the house in spring, when the male utters his melodious notes, so pleasant to the ear. Three species like *Oreocinchla dauma aurea*, *Cichloselys sibiricus davisoni*, and *Calliopo calliope calliope* are found here, of which the first, though maintaining a local migration in autumn, is found from Hokkaido in the north to as far south as Formosa. On the contrary, the second species is distributed from Saghalien to Kyushū and Korea. As a summer resident it appears and breeds in the above named districts, and migrates southwards during the autumn and winter months. These two birds are worthy of economic notice, being useful as destroyers of harmful insects. The third species has a wide range, being found nearly all over this country. Flitting about between the banks of the Haya and Sukumo rivers is to be found *Cinclus pallasii pallasii* which ranges over the region north of Kyushū. Amongst the birds noted for their songs or musical notes we also find *Troglodytes troglodytes femigatus*, the waxwing (*Bombycilla japonica*), the tree-creeper (*Certhia familiaris japonica*), the tits, and others.

On the extensive grassy plain of Sengoku-hara are such species as the green pheasant (*Phasianus versicolor versicolor*), the copper pheasant (*Graphophasianus soemmerringii scintillans*), and the quail (*Coturnix coturnix japonica*). The pheasants appear to be limited in distribution to Honshū and afford shooting, either for sport or market, during the late autumn and winter months. The quail, of which the male and female look so much alike, are familiar bird in various parts of the country. Their eggs are in demand as food for certain invalids.

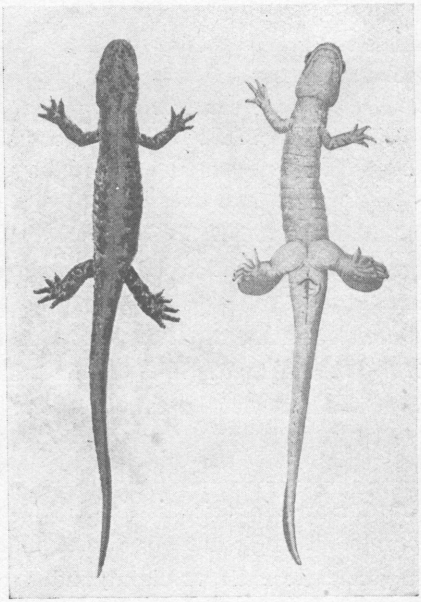
Of snakes, two species are often met with, viz., *Elaphe quadrivirgata* and *Agkistrodon blomhoffii*. The latter is extremely poisonous, its bite being often followed by fatal results. It goes by the common name of "Mamushi" in Japanese, and seems to be especially abundant on Mts. Kintoki and Futago.

The only lizard found in this district is *Eumeces latiscutatus*, which is quite common, though not often seen unless searched for. It is found creeping on stone walls, or hiding under stones.

Living in the lake are two species of turtles, *Clemmys japonica* and *Amyda japonica*, which are not found outside of Japan. The

latter is soft-shelled and furnishes delicious food. It is now being bred in various parts of the country.

In this district six species and varieties of frogs and toads are of common occurrence. The toads are represented by two forms of *Bufo vulgaris japonicus* and *formosus*, of which the former is found all over Japan proper, while the latter flourishes only in the northern part of Honshu. Their skins are used in the manufacture of card-cases and the like. Amongst the frogs we find the following four species: *Rana temporaria ornativentris*, *R. rugosa*, *Polypedates buergerii*, and *Rhacophorus schlegelii* var. *arborea*. *Poly. buergerii* inhabits clear waters and has been celebrated in our poems. for its loud notes "Koro-koro-koro!" in summer. It is sometimes kept as a pet. The arboreal form of *Rh. schlegelii* deposits its egg-mass so that it may hang down from the leaves of trees which project over the water. Its range is from Kyoto in the south to Aomori in the north.



Onychodactylus japonicus. *a* female, dorsal aspect; *b* male, ventral view. After Tago.

Worthy of notice is the salamander (*Onychodactylus japonicus*) which, although it is called "Hakoné-sanshouwo" from its type locality, is not confined to this district, but is found in abundance in the mountainous districts of Japan proper. In this region it abounds in the streams at Kiwada-sawa near Hata on the river Sukumo, at the foot of Mt. Myōjin-daké as well as near the Nagao tunnel. This species may attain a length of more than six inches, and is on the dorsal surface of the body of a wood-brown colour, sprinkled more or less with blackish brown, the spots being dense on the head. Its peculiarity lies in the fact that its toes are armed with black nails. In this country it is used for medicine either raw or well-roasted, though its efficacy is quite uncertain. The same is true of the common newt (*Diemictylus pyrrhogaster*) which also inhabits the waters of this district.

Confined to Hakoné Lake and the larger streams connected with it, there are the following principal fishes: *Oncorhynchus nerka*, *O. masou*, *Salvelinus malma*, *Hypomesus olidus*, *Plecoglossus altivelis* (Salmonidae); *Parasilus asotus* (Siluridae); *Misgurnus anguillicaudatus* (Cobitidae); *Richardsonius hakuensis*, *Cyprinus carpio*, *Carassius auratus* (Cyprinidae); and *Anguilla japonica* (Anguillidae).

In order to propagate food and game fishes the first four of the Salmonid-species just mentioned have been brought from some other lakes, such as Chūzenji, Biwa, and Kasumi-ga-ura. Under certain conditions, however, trout hatcheries have been maintained without desirable results. The most edible fish in the lake is *R. hakuensis*, which is one of the most widely distributed of Japanese river fishes. Because of the reddish colour of its abdomen in the breeding season, it is called "*Akahara*" in Japanese, and is caught annually in immense quantities. Quite recently an attempt has been made to introduce the black bass from America.

Inhabiting the lake is a shrimp of moderate size, which may be the *Leander paucidens* described by de Haan. *Potamon dehaani* is the one land crab, but it is seen on all sides near the water.

The lower crustaceans are numerous in the lake, including various forms which belong to the genera *Cyclops*, *Sida*, *Diaphanosoma*, *Daphnia*, *Scapholeberis*, *Bosminopsis*, and some others. They contribute the larger part of the plankton.

Insects are very much in evidence. Their presence on all sides in great variety and beauty makes them highly attractive to visitors.

Up to the present, a large number of species of beetles, butterflies, moths, and other insects have been placed on record from this district. Amongst the beetles the carabs are represented by some interesting species, such as *Cicindela chinensis*, *Carabus mayasanus*, *Pseudophonus ruficornis*, *Colpodes aurelius*, *C. hakonus*, *Stomis prognathus*, *Bembidion niloticum*, *Lachnoderma asperum*, and others. The Rhysodidae are known, with a few species, such as *Rhysodes crassiusculus*, *Rh. niponensis*, *Laemophlocus cribratus*, *Hyliota arborea*, *Pseudotriphyllus rufitarsis*, *Triphyllus seriatus*, and others. Of other families the species recorded hitherto are as follows: *Platambus fimbriatus* (Dyticidae); *Hydrocyclus lacustris*, *Philydrus subsignatus*, *Berosus punctipennis*, *Ochthebius inermis*, *Cercyon rubicundus* (Hydrophilidae); *Labomimus reitteri*, *Batrisus basicornis*, *B. fallax*, *Bryaxis latifrons*, *Bythinus japonicus* (Pselaphidae); *Silphida japonica* (Silphidae); *Hister sutus* (Histeridae); *Heterhelus morio*, *Epuraea funeraria*, *Meligethes mikado*, *Aethinia aeneipennis*, *Cychramus lewis*, *Strongylus breviusculas* (Nitidulidae); *Macrodorcas rubrofemoratus* (Lucanidae); *Lycus quadricollis*, *Platycis nasutus*, *Lyponia delicatula* (Cantharidae); *Lemula decipiens*, *Omphalodera pugiloi*, *Grammoptera amentata*, *Anaglyptus nipponensis* (Cerambycidae); *Phytodecta robusta*, *Melospila eburata*, *Argopus clarki* (Chrysomelidae); *Coccinella bruckii* (Coccinellidae), and others.

Butterflies are numerous, and find a veritable paradise on the grassy plain of Sengoku-hara, where almost all of the species are found. Amongst the Papilionidae such species as *Papilio machaon*, *P. alcinous*, *P. demetrius*, and *P. sarpedon* are common. The Pieridae are represented by *Pieris rapae*, *P. melete*, and *Colias hyale*, which occur in great abundance. Of the Satylidae the following species can be seen: *Ypthima argus*, *Satyrus dryas*, and *Neope goschkewitschii*. The common species belonging to the Nymphalidae are *Argynnis adippe*, *Ar. ruslana*, *Ar. paphia*, *Neptis hylas*, and *Limenitis sibilla*. Amongst species of other families the following are those often met with: *Danais tytia*, *Polymmatus boeticus*, *Celastrina argiolus*, *Parnara guttata*, and others.

Moths are plentiful in this district, the most common species being those belonging to the Noctuidae. They are *Herminia griserda*, *Rhynchma morosa*, *Blasticorhinus ussurensis*, *Mocis undata*, *Exiopus aethiops*, *Euxoa segetum*, *Agrotis exusta*, *Ilattia stellata*, and others. The Lithosiidae are represented by *Lithosia griseola*, *Miltochrista*

miniata, and others. Of the Arctiidae a few species, such as *Rhyparioides rubescens*, *Diacrisia menthastri*, *D. inqequalis*, *D. imparilis*, and *D. nivenus* are common. There may also be observed a number of other species, such as *Pidorus glaucopis*, *Cosmotricha potatria*, *Dasychira pudibunda*, and *Dilina christophi*.

Leaping about in the grass are such orthopterans as *Stenbathrus bicolor*, *Parapleurus alliaceus*, *Diestrammena marmorata*, and *Gryllodes mitratus*. The latter two, with some others, fill the air with their beautiful notes. Of hymenoptera one of the most notable is a species which may be referable to *Agriotypus armatus*. Its habit is to go under water and lay its eggs in the larvae of trichoptera. The resultant larva lives inside the cases of species of *Silo* and some others which are attached to stones. It is found in abundance in the lake. To be seen everywhere in flight are various species of dragonflies, *Panorpa*, *Megaspis*, *Promachus*, *Ammophila*, and many others. Some cicadas, such as *Tanna japonensis* and *Meinuna opalifera*, inhabit the open forest, making a charming medley of sound. No mosquitoes are represented in this district.

In the cryptomeria avenue by the lake or in the thick forest are found in fair abundance spiders, which include such species as *Velima valida*, *Oligolophus japonicus*, and others.

The common species of molluscs recorded from the lake are *Vivipara japonica*, *Corbicula leana*, *Anodonta woodiana*, *Nodularia haconensis*, and some others. The last named species is peculiar to this locality. Besides, a few snails are known to occur on all sides of the district.

The leeches often seen in the waters, clinging to stones and other objects, are *Glossiphonia complanata*, *Herpobdella atomaria*, *Mimobdella japonica*, and *Odontobdella branchardi*, of which the last two are found occasionally on the land. Frequenting the moist land are *Orobdella octonaria* and *Haemadipsa japonica*, of which the latter is known to extend as far north as Kinkwasan.

Amongst other animal groups the rotifers are pretty numerous, being found intermingled with other planktonic forms in the lake. In clear streams, clinging to the under side of stones of other sunken objects, is found the widely distributed planarian, *Planaria gonocephala*.

The protists are well represented, and many species occur in the lake. Of rhizopods the fellowing species have been recorded:

Amoeba radiosa, *Centropyxis oculeata Pixidicula cymbalum*, *Lecquereusia spiralis*, *Diffugia lebes*, *Pontigulasia spectabilis*, *Quadrulella symmetrica*, *Nebela triangulata*, *Paulinella chromatophora*, *Cyphoderia ampulla*, *Euglypha alveolata*, *E. laevis*, and some others. Besides, flagellates and ciliates are known, each with a number of species, of which the majority are the same forms as are found all over the Old World and America as well.

GEOLOGICAL GUIDE TO THE HAKONE DISTRICT

By Yoshichika Oinouye and Giichiro Kobayashi

GENERAL REMARKS ON GEOLOGY

The Hakone district is a popular year round resort for both foreigners and Japanese. Its location in the heart of Japan in the midst of the most imposing scenery, combined with the extreme purity of the atmosphere, the tonic and exhilarating qualities of mountain climate and the beneficial effects of many thermal springs make it one of the most frequented spots in the whole empire. The traveler goes commonly to the district from the east through the town of Odawara where he has frequent through train service from Tokyo on the Atami railway line. From the west, he can reach the district through the towns of Gotemba and Mishima.

The Hakone district is one of the most famous volcanoes in Japan; it lies in the Fuji volcanic zone which runs across the middle part of Honshū nearly along the boundary that divides Japan tectonically into two parts, north and south. The highest peak of the volcano attains a height of 1,439 m. above sea level, and is isolated on all sides except on the south, where it continues to the volcanic chain of Izu. On the west, the beautiful cone of Mt. Fuji can be seen standing, and on the north the Tanzawa mountains rise, while on the east the waters of the Sagami Bay wash the foot of the volcano.

The Hakone volcano has a large crater within which there are six central cones with an atrio lake on the west. The crater is more

or less oval in shape, being 12.8 km. from north to south and 7 km. from east to west. The chief eminences on the crater wall are those of Mts. Kintoki (1,213 m), Mikuni (1,102 m), Kurakake (1,004 m) and Myōjin (1,166 m). Inside the crater wall are several villages with a total number of nearly 9,000 inhabitants, and though each has a special name, they are usually known under the collective name of the Hakone district.

The central cones are arranged linearly in the direction NNW-SSE through the middle part of the crater. They are, counting from the north, Kami-yama, or "God Mountain" (1,439 m), Koma-ga-take or "Pony Peak" (1,326 m), Kami-futagoyama, or "Upper Twin Mt" (1,090 m), Shimo-futago-yama, or "Lower Twin Mt." (1,064 m), Byōbu-yama, or "Screen Mt." (948 m). In the southwestern part of the crater, there is an elongated mountain lake, called Ashi-no-ko, or "Lake of Reeds," 6.5 km. in length and 1 km. in width, occupying a space lying between the crater wall and the central cones. It is surrounded by steep walls, overgrown with trees and bushes; the water is cold and clear and the deepest point reaches to a depth of 43 m. The reflection of snow-clad Mt. Fuji in the placid waters of the lake is one of the sceinc curiosities of the place.

The basement rock of the volcano consists chiefly of tuffites of the younger Tertiary. The beds composing the mountain itself are of light yellow tuff-breccia containing various sized fragments of variegated andesite with here and there intercalations of fine white tuffs in layers. These layers dipping steeply towards the NE are exposed along the valleys of the Haya-river and the Sukumo-river.

The lava-flows which form the crater well as well as the central cones, belong to the group of pyroxene-andesite. The majority of the flows are grey in colour, and holo-crystalline and compact in texture, while some are glassy or platy.

The order of the lava flows and the lithological character of the lavas of the Hakone volcano are as follows :—(from older to younger)

(A) Lava flows of the crater wall.
  (1) Hiraishi type lava.
  (2) Umijiri type lava.
  (3) Yamabuse type lava.
  (4) Tateishi type lava.
  (5) Myōjō-yama type lava.
  (6) Ashigara-yama type lava.

(7) Takakura-yama type lava.
(8) Nebukawa type lava.
(9) Myōjin-yama type lava.

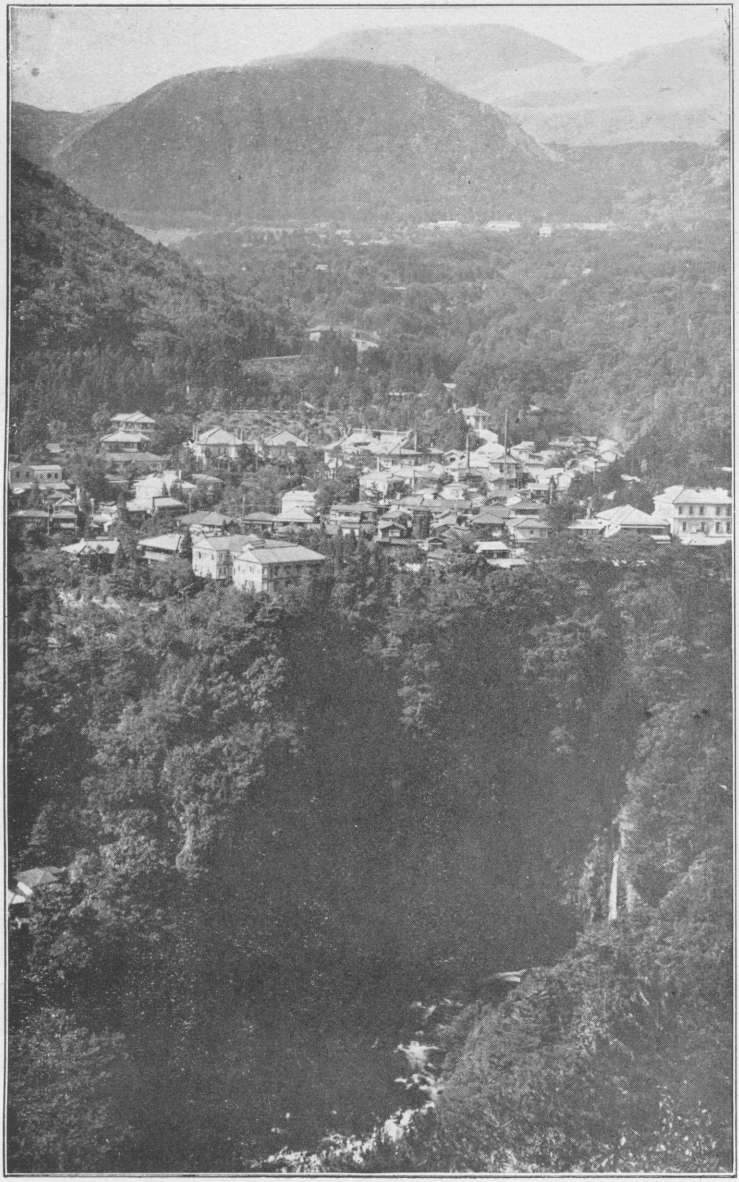
(B) Lava flows of the central cones.
(1) Byōbu-yama type lava.
(2) Takanosu-yama type lava.
(3) Futago-yama type lava.
(4) Komagatake type lava.

Among the lava flows of the crater wall, the Hiraishi and Umijiri type lavas belong to the hypersthene-andesite group; the Tateishi type lava, to the hypersthene-augite-andesite; the Yamabuse, Myōjō-yama, Ashigara-yama and Myōjin-yama type lavas, to pyroxene-andesite containing olivine; the Takakura-yama and Nebukawa type lavas, to augite-andesite. The lava flows which form Byōbu-yama and Futago-yama are hypersthene augite-andesite; and the lava flow of Komagatake is pyroxene andesite containing olivine.

Remarks:—The recent volcanic rocks which are widely spread through the Japanese archipelago are commonly called "pyroxene-andesite." Strictly speaking, however, they are different from the typical "andesite." In general, Japanese "andesites" are characterized by rather low silica, high lime, and low alkalies. In petro-chemical calculation, the silica, in spite of its low percentage, is more than enough to form the highest sili ates, leaving some silica in a free state, though the quartz is occult in the mode. The normative quartz is usually found in such quantity that the rocks belong to the quardofelic order of Qn. S. The normative plagioclase, on the other hand, is labradorite, i.e., more calcic than it is in the typical andesite in which it is andesine. The "pyroxene-andesite" of Hakone is not exceptional in respect to what has been mentioned above.

Along the valleys of the Haya-kawa and Sukumo-gawa, occur a number of dykes of one to ten m. in width, cutting through the basal tuffite as well as the lava flows. Of these the larger ones are found only on the way from Sokokura to Ashi-no-yu, while the smaller ones which are narrow, though long, are observed on the banks of the Sukumo river opposite Hatajiku. These dyke rocks consist almost always of augite-andesite, often containing hypersthene as an accessory ingredient. It is light grey in colour and compact in texture, though it is porous in the central part and more or less glassy and black at the periphery. In most cases the

Komaga-take



Miyanoshita Spa.
The River Hayakawa.

the mountains are covered with a brown loam of considerable thickness, which is composed of volcanic ashes and sand mixed with clay. Gravel and sand deposits are found at places on the banks of the valleys of the Haya river and the Sukumo river or at the mouths of the ravines around the lake.

ITINERARY

From Odawara to Miyanoshita

Going westward from the town of Odawara along the river Haya, the traveler can not fail to see far in front an imposing view of the picturesque cones of Futago-yama ("Twin Mountain") and Komagatake ("Pony mountain"), which rise high above the mountain peaks of the eastern crater wall. The valley of the river Haya (Hayakawa) which is an outlet of lake Hakone is wide until it approaches Yumoto. The mountains on both sides of the river are composed of tuffite, lava flows and agglomerates. Near Sammaibashi, on the top of a cliff on the south bank, a lava flow of fine columnar structure is exposed.

Yumoto is the gateway to the Hakone district and the first group of thermal springs can be seen there; it is 7 km. up from the town of Odawara and a drive of twenty minutes is quite enough to reach it. The Sukumo river which has its source at Mt. Kurakake joins the river Haya at this place. Proceeding 700 m. farther, the traveler comes to Tōnosawa, the next spa. The river Haya forms gradually a narrow gorge and the road begins to wind along its course. The banks of the river form cliffs and these cliffs are composed mostly of tuffite, through which many small dykes of augite-andesite have pierced. Lava flows can be seen in the upper part of the cliffs and a few small cascades fall over them. There are many points of interest near these two places.

From Tōnosawa westward, exposes a tuffaceous rock is exposed, showing beatiful bands; this rock is the basement rock of the Hakone volcano. A black agglomeratic mud-flow at Ōhiradai is noted; it is believed to have flowed down from Kami-yama. It has a thickness 7 more than 20 m. The valley becomes a little wider from Ōhiradai upward. Proceeding in this direction, the traveler will come to Miyanoshita, the centre of the Hakone district. It is situated

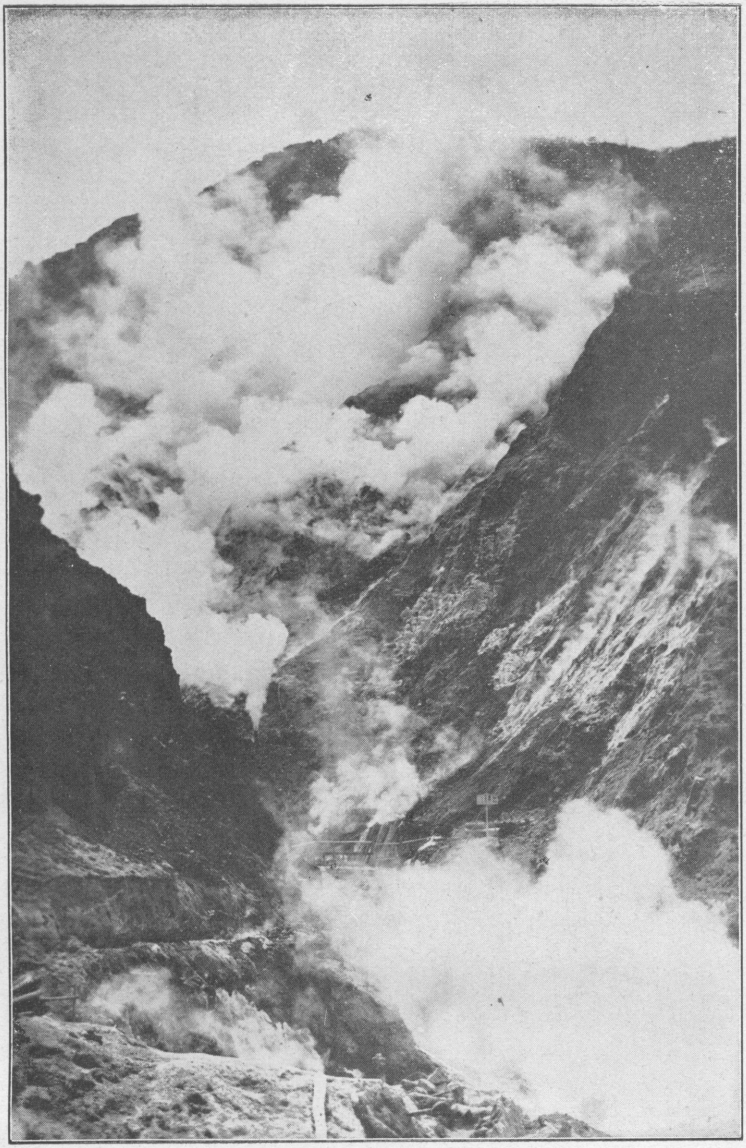
on a terrace 416 m. higher than the water level of the Haya-river and is famous for its thermal springs and for the Fujiya Hotel.

From Miyanoshita to Gōra

Crossing a gorge called "Jakotsu-gawa," in which the main source of the hot springs ef Miyanoshita is located about 100 m. up from the bridge, we follow a narrow path along a steep cliff, passing Sokokura and Kiga, until we come to the bridge of Miyagino. Going up a winding road from the bridge, we come to the entrance to Gōra Park, which is located about 100 m. above the stream and occupies a sloping ground made up of mud-flow. Several villas are scattered among the green trees, each with a hot spring. Taking a cable-car, and going about 210 m. higher up, within 10 minutes we are in the highest part of the park (762 m.). From this point a splendid, comprehensive view may be had of mountains, valleys, various spas at the foot, and Sagami Bay at a distance. Within 30 minutes walk to the west from Gōra, is Ōwakidani, the largest solfatara in the district, where subterranean roaring, boiling water, sulphur sublimation and many other interesting phenomena will attract the attention of the tourist.

From Miyanoshita to Nagao-tōge

Over the bridge mentioned above, the road leads to Miyagino basin which is a part of an old atrio, but is now covered with ashes and loam. Facing Kintoki peak, we cross a small gorge called "Choshi-kuchi" where a thick dark-grey mud-flow is exposed. A field called Sengoku-hara, also a part of an old atrio, extends south-westward to the Ashi-no-ko; being surrounded by mountains, it appears to be a deep valley. From the village of Sengoku-hara, situated at the eastern end of the plain, we ascend a road cut along the steep slope of the crater wall which is composed of basaltic agglomerate, and reach the top of Nagao-tōge (Pass) where there is a short tunnel. From this point we get a splendid view of Lake Ashi on one side and Mt. Fuji on the other, a sight unrivaled in beauty. On a clear day Mt. Fuji can be seen from the base to the summit and it is especially magnificent when entirely snow-clad.



Solfatara in Owakidani.

From Miyanoshita to Hakone

Following the zigzag road along the valley of the "Jakotsu-gawa," where hot-springs issue from an agglomerate and there occurs a large dyke of compact grey angite-andesite, we reach Kowaki-dani ("Valley of lesser boiling") where are two inns for tourists. In the spring the beautiful cherry blossoms attract many visitors. Here the valley of the Jakotsu-gawa runs northward with a still active fumarole nearby. From Kowakidani the road winds up a slope to Ashi-no-yu (850 m.) between Koma-ga-take and Futago-yama, which is noted for its sulphuretted hot spring. Going about 300 m. up from Ashino-yu through the valley between the two cones of Koma-ga-take (on the right) and Futago-yama (on the left), we find, on the right-hand side of the road, an andesite block with a Buddhist image carved in relief, which is well worth a moment's inspection. The chief object of interest on the road, however, is a large image of Jizō carved in relief on a block of andesite. A few hundred meters to the west there is a trail leading to Koma-ga-take, which is composed of augite-hypersthene-andesite. From the summit, one may enjoy a panoramic view of the surroundings of the volcano: on the west, the Akaishi mountain range behind Mt. Fuji; on the east, the Kwantō plain and the Bō-sō peninsula; and on the south, the Pacific Ocean with a number of petty volcanic islands among which stands the smoking cone of Ōshima, the largest. Along the foot of Koma-ga-take there are several exposures of grey pyroxene-andesite lava. From its junction with the trail, the main road descends over volcanic detritus to Moto-Hakone.

Moto-Hakone (724 m.) is a pleasant and picturesque village situated at the southeastern corner of the lake. The Hakone shrine is a place of interest which may be reached by a short walk from here. Proceeding along the lake, we come to a famous avenue of cryptomeria trees and then to To-ga-shima, a promontory on which is situated an imperial summer residence. A view of the summit of Mt. Fuji towering above the Hakone mountains is very attractive. A visit to the relics of an old barrier gate, which is at the entrance to the village of Hakone-machi, should be made. It was built in 1618 across a narrow road with a mountain on one side and the lake on the other, and was of strategical importance in former times, all travellers along the Tōkaidō being strictly inspected here. The barrier was removed in 1871, but a remnant of the stone pedestal may still be seen.

Ashi-no-ko, the present lake, is a remnant of a large lake which covered the whole bottom of the crater before the central cones were formed. Its deepest place located a little to the south of the center of the lake, is 43 m. Submerged in the lake are several big trees, among which the so-called "Sakasasugi," a large cryptomeria, is most noteworthy. It is an erect trunk standing in the bottom near Kame-ga-saki, measuring 33 m. in length and 6 m. in circumference at the base. How these trees were submerged is a matter of question, but their submersion may have been caused by the depression of the foot of the crater-wall or of a central cone bordering the lake, overgrown with such big trees.

Hot Spring

In the Hakone district, hot springs occur around the central cones, mostly on their eastern foot along the valley of the Haya-kawa. There are twelve spas with hot springs issuing from vents of tuffite, andesite dykes, muddy agglomeratic flows and volcanic detritus. The chemical composition of spring-waters in a spa varies but little. On the whole, however, a classification into six kinds may be made: Saline sulphur, Acid hydrogen sulphide, Acid vitriol, Sulphur, Simple thermal and Common salt. The first four are found chiefly in high altitudes, while the others occur in low places. Sometimes the surface water heated by solfataric gases is used for bathing purposes, mixed with a little natural spring water as in Sengoku-hara and Kowakidani. The kinds and temperatures of the various springs in Hakone are tabulated below:

Names of spas	Kind	Temperature (c)	Rock
Yumoto	Simple thermal	44°–58°	Tuffite & Andesite dyke
Tōnosawa	,,	,,	,,
Miyanoshita	Common salt	71°–78°	Muddy agglomeratic flow
Sokokura	,,	72°	,,
Dōgashima	,,	46°	,,
Kiga	,,	46°	Tuffite & Andesite dyke
Kowakidani	Acid vitriol	61°–71°	Andesite lava-flow
Gōra	Saline sulphur	65°	,,
Ubako	Simple thermal	38°	Muddy agglomeratic flow
Sengoku-hara	Saline snlphur	57°	Andesite lava-flow
Ashi-no-yu	Sulphur	36°–43°	Detritus
Yunohanazawa	Acid hydrogen sulphide	40°–80°	,,

BRIEF PETROGRAPHIC DESCRIPTIONS OF THE HAKONE LAVAS

Lavas of the Somma.

(1) Takanosu Lava. Two-pyroxene-andesite.
Gray, compact, dopatic.
Phenocrysts: plagioclase comparatively abundant; hypersthene and augite small and rare; magnetite sporadically present.
Groundmass: percrystalline, consisting of plagioclase, augite, and magnetite, with a small quantity of glass.

(2) Sengen Lava (I) at the top of Sengen-san. Two-pyroxene-andesite.
Dark gray, sempatic.
Phenocrysts: plagioclase, hypersthene, augite, and magnetite.
Groundmass: docrystalline to hyalocrystalline, consisting of plagioclase laths, augite and magnetite grains, and interstitial glass.

(3) Sengen Lava (II) at Ōhiradai. Two-pyroxene-andesite.
Gray, compact, dopatic. Phenocrysts are rarer than in the preceding type, while the groundmass is a little higher in crystallinity.

(4) Byōbuyama Lava. Two-pyroxene-andesite.
Gray, compact, dopatic.
Phenocrysts: chiefly plagioclase, pyroxenes very rare.
Groundmass: docrystalline, consisting of very minute crystals of plagioclase, augite, and magnetite, with interstitial glass.

(5) Myōjō Lava. Two-pyroxene andesite.
Of the same type as the Sengen lava (I).

Lavas of the Central Cones.

(6) Kamiyama Lava. Olivine-bearing two-pyroxene-andesite.
Gray with reddish shade, sempatic.
Phenocrysts: plagioclase, hypersthene, augite, magnetite.
Groundmass: docrystalline to hyalocrystalline, consisting of plagioclase laths. augite and magnetite grains, and interstitial glass.

(7) Futago Lava. Two-pyroxene-andesite.
Gray with purplish shade. Olivine is absent from the specimen examind; but in other respects the rock is quite similar to the preceding type.

(8) Komagatake Lava. Two-pyroxene-andesite.
Of the same type as the preceding lava.

Geological Map of the Hakone Volcano

Tuffite.

Sukumogawa type agglomeratic lava.

Hiraishi type lava.

Umijiri type agglomeratic lava.

Umijiri type lava.

Biyōbuyama type lava.

Yamabuse type lava.

Tateishi type lava.

Takanosuyama type lava.

Myōjōyama type lava.

Ashigarayama type lava.

Takakurayama type lava.

Nebukawa type lava.

Myōjinyama type lava.

Futagoyama type lava.

Komagatake type lava.

Kamiyama mud-flow.

Ōhiradai agglomerate.

Lapilli, volcanic sand, ash and loam.

Alluvium.

Crater

Explosion crater

Thermal spring

Scale 1:50000

0 1 2km

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