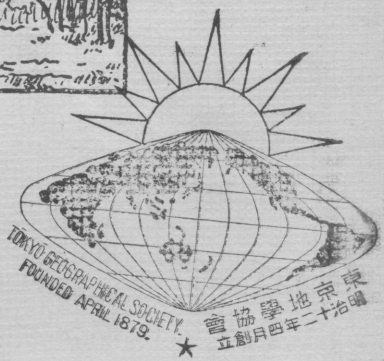
GUIDE-BOOK EXCURSION C–4

(Nov. 6th–7th, 1926)

THE LAKE DISTRICT AROUND MT. FUJI



PAN-PACIFIC SCIENCE CONGRESS, 1926

JAPAN

Fig. 48. View of Mt. Fuji, seen from Mt. Ashitaka, explanation in the text. Phot. B. HAYATA, Nov. 18, 1924.

THE LAKE DISTRICTS AROUND Mt. FUJI

CONTENT

GUIDE TO THE BOTANY OF MT. FUJI

A SUMMARY OF THE FLORA AND VEGETATION OF MT. FUJI*

By Bunzō Hayata

INTRODUCTION

On the coast of the Pacific, towering more than twelve thousand feet above the sea, stands Mt. Fuji, symmetrical in shape and rich in vegetation, a fitting emblem of the Japanese nation. Since my college days, nearly thirty years ago, I have been specially interested in the flora and vegetation of this beautiful mountain. In 1911, I published "The vegetation of Mt. Fuji," giving the results of studies made mostly in my student days. That work, however, had been carried on with an immature mind and was essentially preliminary in its nature. Ever since then, it has been my desire to work it up again according to my present ideas.

Thus, it was my great good fortune when by the kind favour of Dr. Y. Kozai, President of the Imperial University of Tōkyō, I was recommended to Dr. K. Honda, President of the Bureau of the Imperial Preserves, who most obligingly arranged a grant-in-aid by the Bureau for my work on Mt. Fuji which belongs partly to the Imperial Estates. Through the kindness of Dr. Honda, I have been able to carry out the present work under the auspices of the said Bureau. To these gentlemen, Doctors Y. Kozai and K. Honda, and also to Mr. K. Takahashi, Vice-President of the Imperial Preserves Bureau, I desire to tender my hearty thanks for their gracious interest in my work.

* This paper will be published in full in the course of the next year.

It will not be out of place here to add a few words as to how I was led to lay the present note and the plan for the excursion to Mt. Fuji, before the Pan-Pacific Science Congress. While working, in March 1924, at the base of the mountain, I was singularly struck with the fact that there was certainly some difference between the vegetation which I then had before my eyes and that which I had seen there nearly twenty years before. Although the difference was certainly slight, as was only natural in a change that had taken place in a score of years, a short time when compared with the long age which the history of a plant formation generally describes, yet it impressed me deeply and led me to think of the great changes that must take place in the vegetation in the course of a long period of time. The thought then came to my mind that, if we assume the vegetation of the present time to be represented by a front plane, that of a former time by a rear plane, and the space of time between the two vegetations by the depth between front and rear, then the hexahedron extending between the two planes may be taken as representing all the vegetations showing all the changes undergone in the given space of time. In the present work, I have endeavoured to treat the vegetation not only as a plane, but also as a solid, taking time into consideration, time not of a short interval, but of as long a duration as can be imagined in connection with the present state of vegetation. In other words, to study the vegetation from the dynamic, as well as the static, point of view.

In the course of my study with this idea in mind, I became more and more convinced of the fact that time plays an important rôle in the formation of vegetation; that is to say, it is not entirely because plants are strong or weak that they gain or lose their lands, but partly because of time; that the flourishing finally decline, and the wanning in their turn begin to prosper. It is only during a short period of time that the strong encroach upon the weak, and at last drive them out. In the long run, on the contrary, the strong become weaker and weaker, principally because of their having thriven too much, and begin to wane, till the weak, taking advantage of this opportunity, regain their former lands. Let me explain this with examples which we frequently meet with on Mt. Fuji.

There, at an altitude of 2000 m., there are found pure stands of *Tsuga diversifolia* (fig. 1). Under the dark shade of these woods, we find generally a large number of the young trees of *Abies Veitchii*, but

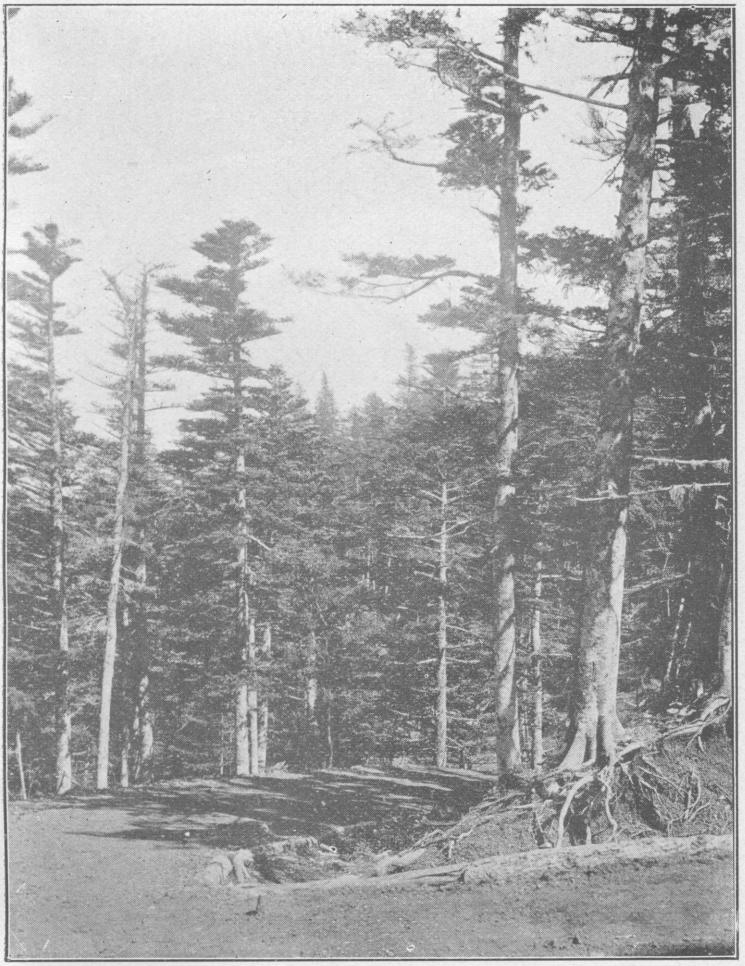


Fig. 1. Coniferous forest on the northern flank of Mt. Fuji at an altitude of about 1800 m. beside the path for the ascent of Mt. Fuji from Yoshida. The forest is composed of *Abies Veitchii*, *Larix leptolepis* and *Tsuga deversifolia*. In this picture, there are seen *Abies Veitchii* on the left in the middle ground, *Larix leptolepis* at the center in the background, showing its apical portion, and *Tsuga diversifolia* on the right in the foreground. Here the *Tsuga* is the oldest and is perhaps about to be replaced by the *Abies*: this latter, after having succeeded for some generations continuously, would be replaced by the *Larix* which in its turn would give way to another conifer, say the *Tsuga*; or they might take another order of succession, being otherwise replaced after one or more, generations. Phot. B. HAYATA, Aug. 1924.

only a very few of the *Tsuga*. Also we frequently meet with cases where the forests of the latter species are about to be replaced by those of the former. This white fir lives a rather short life, and after some generations is replaced by some other plant, perhaps a larch. I have seen many cases of larches in their turn being driven out by *Picea ezoënsis* or *Tsuga diversifolia*. Thus, very roughly speaking, the spruce, fir and larch may be said to flourish turn and turn about.

Attempts have been made in the past to explain this succession of plant formations according to different theories; but, none of them has ever been considered to be satisfactory. No matter how different the theory may be, the fact always remains that a plant which occupies a certain place will in turn be replaced by another of a different kind.

This, I believe, is true, not only of vegetation but also of nations. For this reason I venture to lay this humble note before the Congress and with it my plan for the excursion which is to introduce to the members of the Congress Mt. Fuji, whose beauty we Japanese are never tired of extolling, and through the study of whose plant life I was led to the conclusion above stated.

Finally, I desire to express my gratitude to the councillors of the Congress for their generosity in accepting my offer, and for giving me this opportunity of explaining the vegetation found in an excursion to the mountain.

Bunzō Hayata
Botanical Institute
Tokyo.

January 15, 1926.

I. PHYSIOGRAPHY

A few words as to the physiography of Mt. Fuji will not be superfluous, as physiography is closely related to vegetation. Mt. Fuji, rising from the broad plain between the provinces of Kai and Suruga, is a well defined elevation. It is situated so that the meridian of 138° 44′ East of Greenich, and the parallel of 35° 21′ North intersect near its summit. Attaining the height of 3778 m. (approximately) above sea-level, this truncated cone adds a most graceful feature to the landscape of the Pacific coast. Its foot covers an extensive area, measuring 45 km. from N. to S. and 30 km. from E. to W. Combined with the elevation of the Myōkō volcanic group on the north, Mt. Yatsugataké in the middle, and far to the south Mt. Amagi and the

Izu-Shichitō (seven islets of the Province of Izu), it forms the Fuji volcanic chain, which divides the main island into two parts. Among the volcanoes of this chain, Mt. Fuji, being the one formed most recently, probably in the diluvian age, is thought to have the most recent vegetation. It has Mt. Ashitaka at its very base (fig. 2), and Mt. Amagi some 50 km. to the south. Further on, at a distance of 74 km. to the north-west, is Mt. Yatsugataké with Mt. Komagataké a little nearer. (fig. 3) All these mountains are supposed to have been already extinct, while Mt. Fuji was still active. Therefore, it is highly probable that all these elevations in the vicinity were crowned with rich vegetation, while the young volcano was still bare of any organic growth.

So much for the elevations in the vicinity. Turning now to the mountain itself, it has five lakes at its base, viz:—Yamanaka, Kawaguchi, Saiko, Shōji and Motosu. They are said with great probability to have been originally a semicircular lake skirting the base of the mountain. This lake was afterwards divided into five by the diminution of its water, and also by the intrusion of lava that flowed from the volcano. These lakes give variety to the otherwise monotonous scenery of the basal slope, and on the northwestern flank there is an extensive forest, which is largely due to the underground water that they afford.

Although the mountain is inactive, there is still faint issue of steam on the top,—an indication that the volcano has but recently become dormant. The inclination of the flank near the top is rather steep, measuring 32°-34°, then as one descends the declivity gradually becomes more and more gentle (25°-27°) and at last slopes most gently, league after league, almost to a level. The shoulders of this volcanic cone are in all respects quite symmetrical, and its general outline is comparable to a logarithmic curve, so uniformly do the flanks slope in all directions.

The geology and climate of the mountain, we shall consider under the controlling factors which will be discussed later on.

II. GENERAL ASPECTS OF THE VEGETATION

Observing the vegetation of Mt. Fuji from a distance, we find that there are generally six regions according to different altitudes. They are 1) the grass region, 2) the deciduous broad-leaved forest, 3) the evergreen conifers, 4) the *Larix*-region, 5) the *Alnus-Salix-*

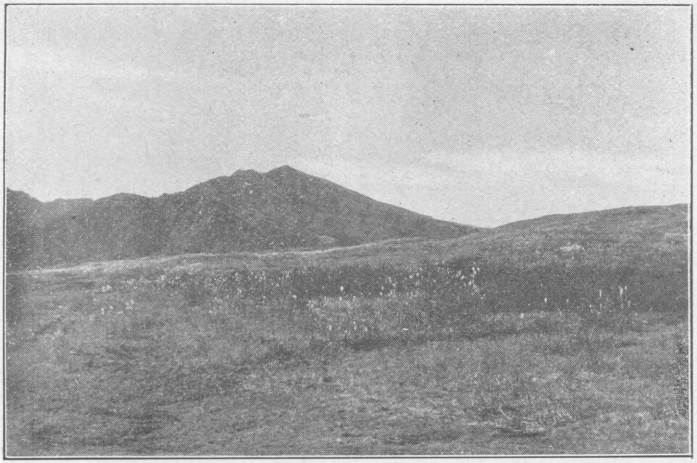


Fig. 2. View of the Ashitaka-range, looking west from Ōnohara. *Miscanthus*-formation in the foreground. Phot. B. HAYATA, Nov. 19, 1924.

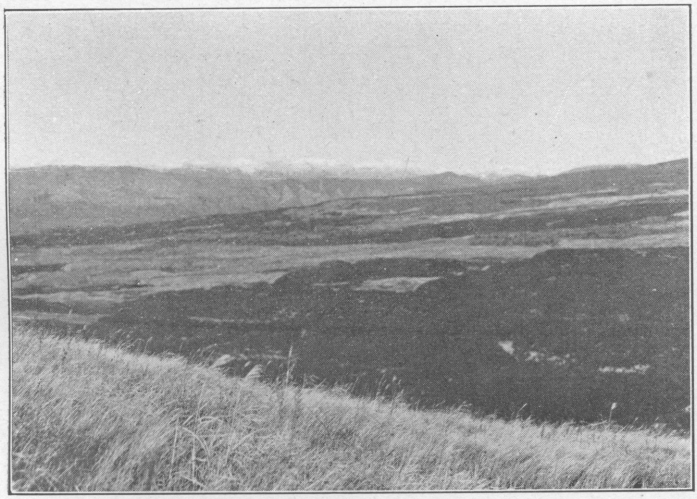


Fig. 3. View of the Akaishi-range, seen from the top of Mt. Ashitaka. Among the snow capped prominences, there are recognizable (from left to right) Mt. Shōgatake (3011 m.), Mt. Akaishigatake (3120 m.), Mt. Uonashikawachigatake (3033 m.), and Mt. Akusawagatake (3146 m.). Phot. B. HAYATA, No. 18, 1924.

region, and 6) the alpine stretches. Above these regions, the cone is entirely bare. Roughly speaking, the formations are observed to be more developed on the south side than on the north. Moreover, the broad-leaved forest is found most luxuriantly on the south, but so scantily on the north that it is likely to escape one's attention from a distance. On the other hand, the coniferous forest attains its most luxuriant growth on the north. This difference in the vegetation, as will be explained later on, is mainly due to the physiography of the mountain on its different sides.

The area of the mountain, to be properly treated in this study of vegetation, is much smaller than that to which we have referred before and measures nearly 500 sq. km. The proportions which the different areas occupied by the respective regions bear to the whole (500 sq. km.) are as follows:—

Grass region	52%
Deciduous broad-leaved tree region	22%
Evergreen conifers	11%
Larix-region	3%
Alnus-Salix-region	2%
Alpine stretches	6%

Above these regions, lies the bare area, which occupies nearly 4% of the whole.

With these preliminary statements, let us proceed to a more detailed discussion. For convenience' sake, we shall divide the mountain into several sectors, and observe them, one after another. First, let us consider the sector on the southeastern side, that is on the side towards Gotemba.

1) Vegetation on the southeastern side

This is a rather well limited area bordered by Mt. Ashitaka on the southwest, and defined by the Kagosaka-range on the northeast. The best view of this sector is obtained from the top of the Otomé Pass (fig. 4). Allow me to quote the following description of the vegetation which I made there on the fine autumnal morning of October 15th, 1924.

"To the west, the truncated cone looks like a flying bird stretching its wings far to the north, and far to the south, its dark body tinted a beautiful rose colour by the morning sun, and in the distance its snow-white crest. Above, the heavens are perfectly blue, as is

usually the case on an autumnal day; but below, the azure sky tends to be a little paler, while about the horizon fleecy clouds are resting quitely. Far below under our eyes, as we look down, is the fertile plain of Gotemba, extending far and wide over hundreds of hectares. Across the plain, at the foot of the mountain, there are seen the dark blue patches of a *Cryptomeria*-forest. A little above it, the rosy light brown zone with very irregular margins above and below is occupied by the *Miscanthus*-formations in the basal region; the grasses in this season of the year all present this same colour. This zone begins at an altitude of nearly 600 m. and ends at about 900 m. Next above, another zone of deciduous broad-leaved trees is shown by a reddish dark brown colour. In the same zone, we notice here and there, especially north of the center, several dark blue areas of a pine-forest. On the southern side, however, no such forest is visible. Above this zone of deciduous forest, there comes a dark blue zone, clearly displayed towards the lateral sides of the cone, but very faintly towards the front. It includs many evergreen coniferous forests, which are principally composed of *Abies*, *Picea* and *Tsuga*. This zone ends at altitudes varying from 1100 m. to 2000 m. Above all the forest-zones and around the dark bare cone, there are visible light brown fringes with very irregular upper margins. These are the alpine stretches, mainly consisting of *Miscanthus Matsumurae*, *Calamagrostis Langsdorffii* and *Polygonum cuspidatum*. The predominating grass in the regions above 2000 m., especially on the northern side, is *Calamagrostis Langsdorffii*. From these fringes upwards, the cone is wholly sterile. Nearly half-way up this bare region and a little to the left of the middle, we notice a monticule, called Hōyé. Far above, on the truncated top, there is visible the pure white of the fresh snow, just fallen as it were but yesterday, and covering the several small peaks around the crater."

As is shown in the annexed map, the vegetation is most scanty on this side. Indeed, the treeless region extends down as far as to about the 1200 m. line, then giving way to *Picea* or *Abies*, but more especially to the red-pine, formation which is, however, not dense as in the case of the other sides, but very thin in every respect. This scarcity of vegetation is an effect of the eruption of the monticule, Hōyé, which took place nearly two hundred and twenty years ago, and on account of which the ground about there is still unsuitable for a dense forest growth.

Fig. 4. View of Mt. Fuji, seen from the top of Otomé-Pass, showing the vegetation on the southwestern side. Explanation in the text. Phot. B. HAYATA, Oct. 1924.

Fig. 5. View of Mt. Fuji, seen from the top of Mt. Uboshigatake showing the vegetation on the western side. Explanation in the text. Phot. B. HAYATA, Oct. 1924.

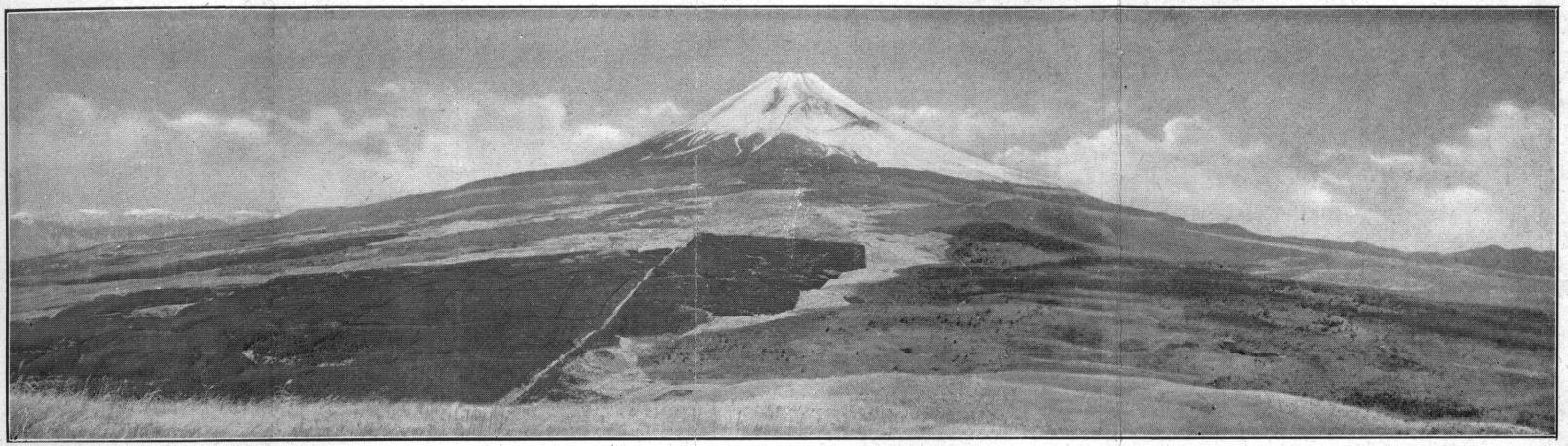


Fig. 6. View of Mt. Fuji, seen from the top of Mt. Ashitaka, showing the vegetation on the southern side. Explanation in the text. Phot. B. HAYATA, Oct. 1924.

2) Vegetation on the northeastern side

Now, turning our attention to the sector on the northeastern side, let us observe the vegetation as seen from the direction of Lake Yamanaka. Here, we find the vegetation differs greatly from what we have just been observing. On this side, the basal grass-region stretches far up to the altitude of 1400 m. From that line upwards, the forest region extends to the height of 2300 m. It is very remarkable that the coniferous formation attains here its most luxuriant growth, while the broad-leaved zone is very poorly represented. On this side, too, many lava-streams with different plant-formations, run through the basal plain, thus giving variety to the otherwise monotonous scenery. Of these streams the one most remarkable, called the Takamarubi, flowed from an altitude of 1400 m. down through the basal slope along a valley called the Namezawa, and extended a little beyond the western extremity of Lake Yamanaka. It is clearly traceable by the forest-patches here and there upon it. The pure stand of *Picea polita* for which this side is noted is, after all, nothing but an example of the forest-patches which usually flourish upon such porous lava.

Travelling along the base of the mountain and coming to the northern flank, one cannot overlook a noble forest extending 2000 m. by 1000 m. When walking along this side, some twenty years ago, my attention was at once attracted to this forest of dark green conifers. On examining the secluded region, I found, to my astonishment, that it consisted of a pure stand of *Picea polita*. This kind of spruce is not rare on this mountain at rather higher elevations, mixed with *Abies bicolor* and *Tsuga Sieboldi*. But, to find a pure stand of it, so much wider than is seen elsewhere in the Empire, was something more than suprising. The ground here is all formed of large blocks of lava which are very porous and present very jagged surfaces. These characters of the lava have an important relation to the forest-formation upon it. Moreover, underground water is plentifully supplied here by the adjacent lake. The Katsuragawa, an outlet of the lake, flows through this area of lava. Consequently nothing is here wanting to make a luxuriant growth. Towards the end of this beautiful formation, the forest becomes thinner and thinner, until it gives way to stretches of dwarf red pines. The accompanying photograph will give some idea of this pure stand (fig. 7).

With respect to the forest regions stretching within the altitudes

of 1400 m. and 2000 m., there is a remarkable difference between that on the due east side and that on the northeast. In the former deciduous broad-leaved trees predominate, while in the latter evergreen conifers prevail. The difference of rocks may be taken as one of the causes of this dissimilarity. To this fact, I shall return later on.

On this side, an interesting formation deserves special attention. It is a forest consisting principally of *Alnus incana*. Generally speaking, on this gentle slope, wild fires are frequent and consequently the lower lands are mostly left to grasses. But, in spite of the fires and also of indiscriminate felling, both of which are the greatest enemies of natural forests, there is here in this grassy land, at the foot of the western extremity of the Kagosaka-range, a narrow boot-shaped plot with its toe towards the south and its heel towards the north, quite covered with clumps of *Alnus incana*, with a few trees of *Abies homolepis* intermingled. How this curious formation has been formed, I am not as yet in a position to explain satisfactorily.

Another remarkable feature to be observed on this side is a horizontal row of young alders half-way up the lower grass-covered slope. Alders are usually found abundantly on this side and everywhere along valleys, being mostly distributed by means of running water. Consequently they usually spread in vertical columns, up and down the mountain. But, here we find a horizontal row of them in addition to many vertical columns. The former occurs invariably by the side of a lane traversing an interval between one valley and another along a contour line. This fact suggests that the seeds of the alders may have been brought here directly or indirectly by human agency.

3) Vegetation on the due north side

Next, proceeding to the due north side, let us make a general survey of the adjoining sector from Mt. Usobuki beside Lake Kawaguchi (fig. 8). The truncated top seen from here is gouged with a broad shallow waterless fosse which runs obliquely down the mountain, its edges standing out in sharp relief. Thus the cone on its upper part presents nearly the form of two triangular planes leaning one upon the other. Both shoulders of the volcano trail far to its foot, to the east and to the west, and some parts of the land skirting the base of the mountain have already been turned into arable land. The eastern trail extends to Kagosaka Pass, while the western assing a number of the upper monticules such as Usuyama, Yumiizuka

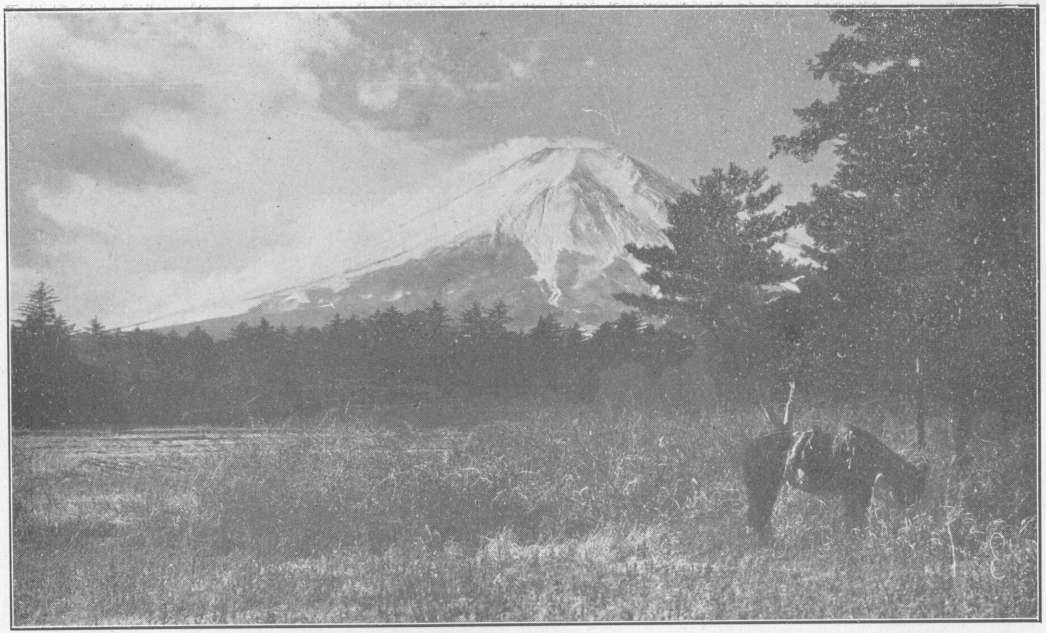


Fig. 7. View of Mt. Fuji, seen from Oshino near Yamanaka. Pure stand of *Picea polita* in the foreground and a little off the middle line. The one dwarf tree is *Pinus densiflora*, the others all *Picea polita*. Of two valleys descending from the snowy region and converging at the center of the cone, the one on the left is the Nagaredashi, and that on the right is a tributary of the Takizawabori. Phot. B. HAYATA, Nov. 1924.

Fig. 8. View of Mt. Fuji, seen from Mt. Usobuki, showing the vegetation on the due north side, and the Tsurugimarubi, flowing from up on the right down towards the left and extending far and wide at the base in the foreground. Phot. B. HAYATA, Jan. 1925.

and Nagaoyama reaches as far down as the lowest, Ōmuroyama. At our feet, we see the arable land of Funatsu, and far up the flank there is a grassy region which extends to the altitude of about 1500 m. Above this region, the deep indigo-blue belt of evergreen conifers ranging from an altitude of 1500 m. to that of 2300 m. divides the mountain into two parts, the waist and skirt. This belt is interesected in its eastern half by three deep valleys which are remarkable in that each possesses a *Larix*-formation from above downwards, while the conifer belt is perfectly continuous in its western half. The valley nearest the center of the cone is called Kawarabori, that next on the east, Takizawabori, and the farthest, Nagaredashi or Mamabori. In the forest belt, a little west of the center, we find a broad and not very distinct monticule called Komitaké. A little lower than the parasitic cone and on its western foot, there is seen the small mound-like monticule, Maruyama, which is partly clad with a thin forest of *Larix*, and partly bare. From the western side of this parasitic cone, descending to the northeast, we see a long stream of lava, rushing down, as it were, in torrents towards the arable plain between Yoshida and Funatsu. This is called Tsurugimarubi. It is covered on its upper half with thin clumps of larch, but on its lower half, with young red-pines.

4) Vegetation on the northwestern side

Our next sector, the fourth, is on the northwestern side and we shall observe it from the top of Mt. Ubōshigataké on the side of Lake Shōji. In the mid-autumn when all these surrounding mountains are aglow with warm tints, the cap of the truncated cone is already more than half covered with snow (fig. 5). The left shoulder of the cone gradually descending northwards, passes Komitaké and stretches as far down as Lake Kawaguchi, while the right shoulder slopes far to the west and comes down to Lake Motosu. Under our feet, we look over an immense expanse of dark green conifers. This is the grand forest of Aogigahara, sometimes called "the Ocean of Woods." On this side, the grassy region is but poorly represented, being found only in rather small areas on the north and west, and the skirt is here mostly occupied by evergreen conifers. This great forest is due to a lava-stream, called Aogigaharamarubi, which flowed down this side nearly nine hundred and seventy years ago. Among these conifers, but quite isolated, we find some areas occupied by broad-leaved trees. These are found on the monticules of Ōmuroyama, Jinzayama, and

Shikanokashira, or on some sandy areas, all having escaped being covered by the lava flow. The rocks of the monticules are usually quite different from those of the lava-streams. This is the principal cause to which the difference between a forest on a monticule and one on a lava bed may be attributed. We shall discuss it later on.

5) Vegetation on the western side

In the fifth place, let us observe the sector on the western side from the foot of Mt. Tenshigatake which stands just opposite the volcano (fig. 9). By October, it has generally snowed several times on the top. From the top of the snow-capped cone, there come down a number of fosses. The left shoulder of the truncated top descends gradually to the north, carrying the several monticules of Okuniwa, Kōsukeyama, Sawarayama and Futatsuyama, and trails far down through Aogigahara to Lake Motosu, while the right shoulder descending through Takabachiyama straight to the plain of Ōmiya, trails far down to the Pacific coast. The basal grassy region on this side never gets above the 1000 m. line, and the forest regions are formed between the altitudes of 1000 m. and 2600 m.

As may be seen in the accompanying photograph, the plant regions on the mountain are displayed very clearly by their own different coloration, especially when the autumn tints begin to glow. The truncated top clad with pure white snow, or sometimes crowned with an umbrella-shaped cloud; the hazy dark, green region of the conifer-forest in the middle; the light red zone of the deciduous forest a little lower down; then light brown to the base, and mile after mile of the grass-formation. The alpine stretches, shrubbery growth and the *Larix*-formation, which lie above the conifer-forest, are clearly distinguishable by their peculiar coloration. The deciduous broad-leaved forest enjoys the most luxuriant growth on this side, and the wonderful wood of *Fagus Sieboldi* is almost without a peer. The latter species is predominant on the southern side, while several kinds of *Alnus* are the most frequent on the northern and eastern sides. This characteristic variation may to some extent be ascribable to the edaphic factors peculiar to the different sides. I shall dwell on this point at length in my paper "Flora and vegetation of Mt. Fuji" which will be published sometime next year.

As there is sufficient heat and considerable rainfall, cultivation is carried on here and there even to the edge of the deciduous growth. The grassy land on this side is said to have been clad formerly with a

Fig. 9. View of Mt. Fuji, seen from a place near Tanukinuma at the foot of Mt. Tenshigataké, showing the vegetation on the western side. Towards the foot of the left shoulder, several monticules are to be seen. The one at the left end is Futatsuyama; the one next above, Sawarayama; then still higher, Kōsukeyama; and the uppermost, Okuniwa. Of many valleys, the central and the largest is the Ōsawa. Phot. B. HAYATA, Nov. 21, 1924.

Fig. 10. Dwarf bamboo-formation on Hiratsuka, consisting almost entirely of *Sasa hiratsukensis*. Three specimens of *Arundinaria Chino* with much smaller leaves may be seen on the right; all the rest are the named species of *Sasa*. Phot. B. HAYATA, May 10, 1925.

dense forest. It is known from the records that in former times clearings were made here, and more conclusively is this testified to by the roots and stumps buried in the soil.

Naturally, the western side of Mt. Fuji, if compared with the eastern or northern side, possesses many valleys usually without water. This shows that on the former side the rocks are sufficiently old to have been considerably eroded by water and chiselled with a number of valleys, while on the latter the rocks are as yet young and consequently show but few signs of erosion.

To enumerate the valleys found on these sides (western and southern) from the most western to the most eastern; the first is called, Kurinokizawa, then come Kanakusozawa, Namezawa, Fukasawa, Kurabonezawa, Aozawa, Ichibeizawa, Nichizawa, Fudōzawa and finally follows Garanzawa. The forests on these flanks traversed by so many valleys have naturally been plentifully supplied with water. No wonder then that we find on these sides the most luxuriant growth, showing each of the zones more distinctly than we have seen them displayed at any place on the other sides of the mountain.

On the western side, there are again several lava-streams running through the forests and grass regions. The most remarkable of these is the one, called Hinokizukamarubi, flowing along the western side of the Ichibeizawa through Shinozaka and reaching the precincts of the shrine of Sengen at Miyauchi, where we find a beautiful pure stand of *Abies firma*. Another stream is followed by the Ōmiya route, another goes on and around Mt. Takabachi and another along the Nichizawa. There are still others. All these are more or less interesting, as they are all crowned with a considerable amount of evergreen conifers,—an indication that there is an intimate relation between the lava and the conifers.

6) Vegetation on the southern side

Finally, let us go round to the south and look at the cone from the middle flank of Mt. Ashitaka (Fig. 6). It was already full spring tide at the foot of Mt. Fuji, when I went there; but it was the dead of winter on top. The bare region on the truncated cone was entirely capped with pure white snow. Seen from this point, the left shoulder trails down as far as to the plain of Numazu, and the right shoulder, running far to the east, passing behind Akatsuka, extends to Kagosaka Pass and then on to Mikuni Pass. In the snow clad treeless region, a little eastward of the center and below it, and at the bottom

of an enormous excavation, is the Hōyé monticule, while far down at the end of the snow-clad foot are a pair of small cones called Futatsuzuka (literally twin mounds). This uppermost region, on the west, stops at an altitude of 2500 m., but stretches far down to the east, to the 1100 m. line. This difference in the extension of the treeless region in the different directions is principally due to the eruption of Hōyé which took place nearly two hundred and twenty years ago. The forest growth is more luxuriant on the western side, but it becomes poorer and poorer, as it goes eastwards. The lower boundary of the forests is generally taken to be at the altitude of nearly 1000 m.; yet, on this side, we see a long radial sylvan band rushing, as it were, like a torrent from the high forest region down almost to the 300 m. line. This is a grouping of many tree clumps on a lava-stream called the Nakabosa. The sparse growth of evergreen conifers on this band indicates clearly, even from a distance, that the clumps are on a lava-stream.

Just before us, beyond the village of Jūrigi, there is seen a thin forest, covering a broad area from Kansuyama downwards to the south. That this is a wood formed on a lava-stream, the Jūrigi-marubi, is clearly shown by the presence of evergreen conifers such as *Chamaecyparis obtusa* or *Abies homolepis*, which stand here and there in the same forest principally of broad-leaved trees. On our right and to the east, across the Jūrigi-forest, we see a grassy band ascending from the basal region far up to the forest-zone. This is an upper extension of the immense plain called Ōhnohara. In the upper part of this plain, there is a mound-like cone called Hiratsuka. This is covered exclusively with a dwarf bamboo, *Sasa hiratsukensis* (Fig. 10). Also, Kansuyama, Mizugatsuka, Koshikirizuka and Higashiusuzuka are seen to be clad mostly, but not exclusively, with several kinds of dwarf bamboos, *Sasa borealis* predominating. These wonderful growths of *Sasa* on these parasitic cones may have been formed as secondary formation after reckless deforestation. If this be the case, it may not be doubted that the rocks constituting these monticules suit the dwarf bamboos so well that no sooner had the trees been cut down than the bamboos found their way into the forest.

Turning our attention to the middle flank, we find a nearly horizontal line of dark evergreen conifers, greatly contracted in breadth by the perspective, in the region of the deciduous broad-leaved trees. This is a pure stand of *Chamaecyparis obtusa* growing on

the upper part of a lava-stream called Minamihinokimarubi, and filling the area between Asagizuka, Koshikirizuka and Higashiusuzuka. On the east of this forest, there is seen another stand of conifers, consisting mainly of *Abies homolepis*, growing on another stream of lava.

III. CONTROLLING FACTORS

Thus we have demonstrated the vegetation, just as it is at the present time. Now let us consider how far it has been determined by what we call outer factors, such as geology or climate. First let us consider the geology of the mountain.

1) Geology

Quite recently the geology of Mt. Fuji has been much elucidated by H. ISHIWARA. The following statements are mainly based upon his work, "The Natural History of Mt. Fuji"*; but are, for convenience' sake, greatly simplified in my redaction.**

The rocks covering the surface of Mt. Fuji may, very roughly, be divided into two kinds:—1) sand and lapilli; 2) detritus or rock-waste. Now, speaking briefly, Mt. Fuji is a truncated cone, covered in its upper parts and on its northern and eastern sides, mostly with sand and lapilli, and in its lower parts and on its southern and western slopes, mostly with the detritus. Moreover, on all sides the mountain has a number of radial ribs of different rocks, which run down through its flanks.

Most of these ribs are lava-streams colloquially called "Marubi," but there are also a few similar strips of sand and lapilli ejected from the monticules, which are much broader than the lava-streams.

Thus the volcano, which appears to be so simple, is in fact rather complex in the structure of its surface. The lava-streams are more numerous on the north side, than on the south. To mention the most remarkable ones from north to south; they are Takamarubi, Hinokimarubi, Tsuchimarubi, Gannoanamarubi, Tsurugimarubi, Demarubi, Aogigaharamarubi, Hinokizukamarubi, Takabachimarubi, Nichizawamarubi, Minami-hinokimarubi, Nakabosamarubi, Jūrigimarubi, Innomarubi and Mishimamarubi. Of the ejectamenta, two remarkable strips are found on the eastern side of the volcano:—one

* ISHIWARA, H.—Fujisan no Shizenkai, the Natural History of Mt. Fuji, (Japanese), 216 pages, 1925. Tōkyō.

** I am much obliged to Mr. *H. Ishiwara* for his kindness in putting his geological map at may disposal, before it was published.

consists of the ejectamenta of Hōyé, and the other of that of Kofuji. Besides, there are many other ejectamenta of sand and lapilli from other monticules which combined with the lava-streams, make the surface of the volcano all the more complicated. Having stated thus much, let us see how far the vegetation is controlled by the geology.

So far as the present state of the vegetation is concerned, the sand and lapilli seem comparatively speaking to suit the red pines, while the detritus is more favourable for the deciduous broad-leaved trees; and again the sand and lapilli ejected from the monticules is likely to suit deciduous trees, while lava-streams must certainly be considered favourable for the evergreen forests.

a) The relation between the lava and the evergreen conifers

First, we shall enumerate the most remarkable cases which show the close relation between the lavas and evergreen conifers.

α. The grand pure stand of *Picea polita* on the Takamarubi.

β. The clumps of *Pinus densiflora* on the Tsurugimarubi.

γ. The great forest of *Tsuga Sieboldi* on the Aogigaharamarubi.

δ. The scattered stands of *Abies homolepis* on the Nichizawamarubi.

ε. The pure stand of *Chamaecyparis obtusa* on the Minamihinokimarubi (fig. 11).

ζ. The pure stand of *Pinus densiflora* on the Mishimamarubi (Fig. 12).

The facts make it very clear that ground consisting of lava-blocks suits the evergreen conifers. Now let me try to explain why it is so. Lava consisting of jagged blocks can contain much water on its surface and consequently, it is all the better for storing this water; because from a smooth, plane surface, water will run off rapidly; but with a rough surface, it has more chances of being retained. Not only has rough ground more power to hold water for plants, but also it supplies young seedlings with shelter sufficient to ensure their growth. Volcanic ash or sand can hold a considerable quantity of water; but an area covered with such materials is necessarily flat and smooth, and in a heavy rainfall, the water is likely to run off from its surface. What makes the matter worse for plant-seedlings is that the area affords no place where plants can fasten their roots and is too flat to have any holes or shady places for the young plants. When strong dry winds prevail, such ground at

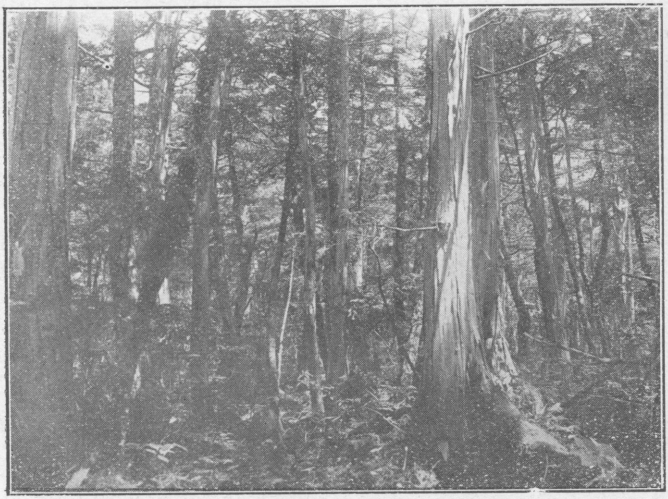


Fig. 11. Pure stand of *Chamaecyparis obtusa* on Minami-hinokimarubi. Phot. B. HAYATA, July 1924, (D.V.).

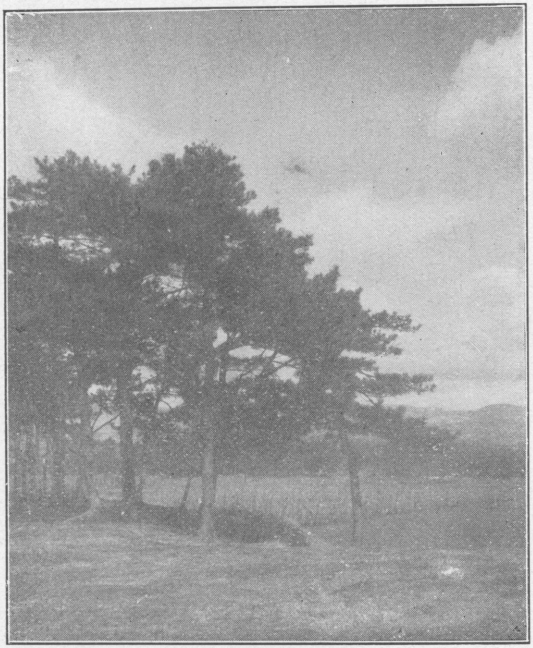


Fig. 12. Pure stand of *Pinus densiflora* on Mishimamarubi. Phot. B. HAYATA, April 4, 1926.

once loses all its moisture and the plants find it difficult to grow. For this reason, it is on a surface covered with jagged blocks of lava, that plants can best take root.

This explains why lava of this kind is better suited to plant-growth than the sand, lapilli or detritus. But, why is it that the evergreen conifers always seem to choose lava rather than other rocks? This I am not in a position to explain exactly. But this much I may say, that the water holding capacity of the lava would permit less fluctuation through the different seasons of the year than is seen in other rocks. To this point I shall return later on under Climate.

b) The effect of the detritus or rock-waste and sand or lapilli on vegetation

Secondly, let us investigate the effect of the detritus or rock-waste and sand or lapilli on vegetation. There are not very many cases illustrating this effect. But, this much may be stated comparatively, not absolutely. On the eastern side, where the ground is generally covered with the sand or lapilli or ejectamenta from monticules, the red-pines are commonly found to enjoy a better growth, while on the western and southern sides, where the ground consists of detritus, deciduous broad-leaved trees flourish best. This is undoubtedly due to the difference of the edaphic factors on the different sides. This point I shall take up again in the discussion in my larger paper.

c) The relation of parasitic cones to vegetation

In the third place, we shall consider the relation which the ejectamenta from monticules bear to these plant-formations. The most remarkable example is the deciduous broad-leaved formation on Ōmuroyama, surrounded, as it were, by a dark green sea of evergreen conifers thriving on the lava-stream. Also the deciduous formations on Nagaoyama, Yumiizuka, Tenjinyama, Katabutayama, Asagizuka and Kansuyama may be mentioned as showing the intimate relation between the vegetation and the monticules. Less significant forests, still equally distinct, if compared with the neighbouring ones, in their possessing the major quantity of deciduous broad-leaved trees or larches, are found on Komitaké, Maruyama, Higashiken, Nishiken and Kotengu.

Here we see very clearly that the ejectamenta suit the deciduous trees; and lava, the evergreens. This, I infer, may be due to the possible difference in their water-holding capacities and their monthly

fluctuations between the ejectamenta and the lava. I have never tried to examine the capacity. Yet, so far as I can conjecture from the distribution of trees, the capacity is smaller, and the fluctuation greater in the ejectamenta, than in the lava. To this point, I shall return later on.

d) The relation between the bamboo-formation and geology

In the fourth place, let us study the relation which the dwarf bamboo formation bears to the rocks. The luxuriant growth of dwarf bamboos of Mt. Fuji is certainly one of the most remarkable features in the vegetation of the mountain. Roughly speaking, the formations are most abundant on the southwestern side, as can be seen in the accompanying Botanical Map, while they are very faintly represented or practically nonexistent, on the northeastern side. This I believe is mainly due to periodic growth, so characteristic of plants belonging to the Bambusaceae. Yet, we should take into consideration the fact that on the southwestern side of the mountain and on the elevations ranging from 1000 m. to 2000 m. where the dwarf bamboos attain their most luxuriant growth, the ground is mostly covered with the detritus, while on the northeastern side, and at the same altitudes as on the other side where there is practically none at all, the ground is composed of sand and lapilli. This fact favours the conclusion that the detritus or waste suits the dwarf bamboos, while the sand or lapilli does not.

e) The effect of the ejectamenta of Hōyé and Kofuji and the sand or detritus upon a plant-formation

Finally, we shall consider the relations between the plant-formations and the ejectmenta of Hōyé and Kofuji on one hand and the sand or lapilli and detritus or waste on the other. The ejectamenta of Hōyé are found on the side of Mt. Fuji that faces nearly due east. Forming a tract in the shape of an elongated triangle, it runs from the parasitic cone far down to the plain of Gotemba. Its southern side adjoins, across a valley, the Makuzawa, the detritus, and its northern side being in contact with the ejectamenta of Kofuji along the foot of the Kagosaka-range. The ejectamenta of Kofuji lie on the due eastern side, forming a band diverging towards the base, and descending from the monticule down to and over the Kagosaka-range. Its northern side is next to the sand or lapilli, across a valley called the Daidōbori, on the northern flank of Mt. Fuji while its southern side touches the northern side of the Hōyé-ejectamenta. Looking at

the forest-growths formed on these different ejectmenta and different rocks from the top of Otome Pass and then from beside Lake Yamanaka, we find on the detritus on the southern side of the ejectmenta of Hoyé the development of deciduous broad-leaved forests; on the same ejectmenta, a fine growth of *Pinus densiflora;* on the ejectmenta of Kofuji again deciduous broad-leaved formations; and finally on the sand or lapilli on the northern side of Kofuji, evergreen coniferous forests.

Although we have distinguished here several kinds of rocks, yet that it is done in most cases merely in a geological sense. Most of them are, in reality, nearly the same, both physically and chemically.* Their edaphic characters, I shall discuss more in detail in the unabridged form of this paper.

2) Climate

As we have stated above, the distribution of different rocks has a close relation to the development of the forests. Independent of this fact, however, there must be certain differences in plant-formations caused by climate. It is, therefore, necessary to consider the climate of the mountain as one of the controlling factors.

As Mt. Fuji lies in the monsoon region, it has a heavy precipitation in the summer, with clear weather in the winter. Accordingly, its vegetation up to the height of 1500 m. is mostly a summer-green forest formation. Above that line, conifers predominate over the deciduous trees. Now let us examine the climatic character of the different sides of the mountain. On the different sides of Mt. Fuji, there are five meteorological stations, varying in altitude from 150 m. to 1000 m. For the present investigation, it is necessary to take into account only the observations made at an altitude of about 1000 m., for the forest formation begins at that elevation. The five stations are not all in the tree region, but it is possible to calculate missing data from the readings made at the base stations.†

a) Rainfall

It is a well known fact that other things being equal, the greater

* Here I would call my readers' attention to the fact that the geological distinctions between rocks are usually more delicate than those of a physical or chemical nature, and that the former are found to exist even when the latter do not. Also it is a fact that plant-formations sometimes show a remarkable difference when the grounds differ geologically, but not chemically or physically.

† I am greatly indebted to Dr. T. OKADA, Director of the Central Meteorological Observatory, for his kindness in furnishing me all the readings mentioned in this paper.

the rainfall the better the vegetation. We also know that the rainfall in the case of a mountain, increases up to the altitude of 1000 m. and then decreases above that line. The rainfall on any flank on a mountain at any altitude can be calculated approximately, if we but know the rate of increase of rainfall for each 100 m. On Mt. Fuji for every 100 m. this is 72 mm. in annual mean of rainfall. Applying this rate to each station, we calculate the annual mean rainfall of the five sides at an altitude of 1000 m., and obtain the results shown in the following table.

Annual mean rainfall at the altitude of 1000 m. on the Shiraito (W.S.W.) side.	2936 mm.
,, ,, ,, Ōmiya (S.W.) side.	2889 mm.
,, ,, ,, Gotemba (E.E.E.) side.	2596 mm.
,, ,, ,, Nakano (N.E.) side.	2942 mm.
,, ,, ,, Shōji (N.W.) side.	2534 mm.

Thus it appears that the Nakano side leads in the amount of rainfall, next come the Shiraito and Ōmiya sides, while the Gotemba and Shōji sides have the least. This climate-character, however, seems to have but slight significance in explaining the present vegetation; for vegetation does not depend so much upon rainfall, as it does upon the soil, ground-water and humidity, the last of which will be considered later on.

b) Temperature

As in the case of the rainfall, we must consider the temperature at the altitude of 1000 m., which temperature can be calculated from the known readings of the thermometer at the basal stations. The following table shows the mean temperature for month and year at the 1000 m. altitude on the respective sides of the mountain.

Months / Sides	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann'l
1000 m. altitude on (W.S.W.) the Shiraito side	3.8	3.6	6.5	10.8	14.4	18.1	20.5	23.6	20.6	15.5	10.7	6.2	12.8
(S.W.) ,, ,, Omiya side	1.9	2.1	5.1	9.5	13.5	17.1	19.7	22.0	19.5	13.9	4.3	4.8	11.5
(E.E.E.) ,, ,, Goten side	0.5	1.1	4.4	9.9	13.2	17.6	19.5	22.9	20.3	13.9	8.8	3.7	11.2
(N.S.) ,, ,, Nakano side	0.9	0.3	4.1	9.8	13.6	18.1	20.9	22.3	19.3	13.5	8.4	3.3	11.2
(N.W.) ,, ,, Shōji side	0.3	0.3	4.1	9.4	13.4	17.9	20.8	21.9	19.7	13.3	7.3	2.7	11.0

On looking at this table, we see that the temperature is highest on the Shiraito side and next highest on the Ōmiya side. Other things being equal, the higher the temperature, the better plants grow. This is clearly shown in the plant formation of Mt. Fuji. On the Shiraito side, the forest is the richest, and the Ōmiya side comes next. On the Shōji side, the temperature is the lowest, but the forest is there favoured by underground water from the adjacent lake, and still more by the porous lava which covers all the ground.* On the Gotemba side, the temperature is comparatively high; but this advantage being offset by the poor soil, we have here the poorest vegetation.

c) Humidity

This most subtle thing plays an important rôle in plant formation. To my regret, we have no observations of humidity at the basal stations of Mt. Fuji. We have, however, one station at Numazu on the extreme outer edge of the southern flank and another station at Kōfu on the north, where observations on humidity are made, and these will answer our present purpose. We may approximately calculate the absolute humidity at the altitude of 1000 m. on the northern flank of Mt. Fuji from that at the Kōfu station; and the absolute humidity of the southern flank, from that at the Numazu station. It is not, however, vapour tension that plays an important part in the formation of a forest; but it is the saturation deficit which is necessary and indeed is the main factor in forest-making. The following table shows the sturation-deficit $E-e_h$ on both flanks.

Month / Sides	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann'l
1000 m. altitude on the north	1.01	1.26	1.61	2.05	2.99	3.82	3.39	3.96	2.4	1.83	1.8	1.46	1.16
1000 m. altitude on the south	1.6	1.9	1.58	1.68	2.36	2.76	3.32	3.81	2.9	2.4	2.39	2.12	1.56

In this table we see that, in January, February, September, October, November and December, i.e. in the so-called non-growing season, the southern flank is much drier than the northern; while the case is reversed in the spring and summer, i.e. in the growing season. This difference of humidity clearly causes the difference in the

* The fact that conifer forests are favoured by porous lava which covers the ground is everywhere met with in Japan. On Mt. Maccarinupri in Hokkaidō for example, we find the conifer forest flourishes on lava, and deciduous trees, on the ground covered with tufas and ash.

vegetation of the two sides. We have previously stated that the vegetation-regions of Mt. Fuji may be roughly divided into two, those of the northern and southern sides. On the north, the evergreen conifers predominate, while on the south there is a most luxuriant growth of deciduous, broad-leaved trees. On the south the air is dry in winter, which does no harm to deciduous trees. In the so-called growing season, the leaves of deciduous trees all come out, and if the air then is dry, it is rather dangerous for such trees, because of the broad leaf-surface which they present for evaporation. In the winter, they have no leaves and, therefore, no surface for evaporation. In short, deciduous trees do not require moist air in winter, but do in spring and summer. In other words, deciduous trees are in no danger of being dried up in the winter, for they have no leaves for transpiration, but in the summer, when all their leaves are out, they are in great danger of losing too much water, if the air is dry. Therefore, deciduous trees do well in a region where the air is drier in winter and moister in summer. This, as may be seen in the foregoing table, is the condition on the southern flank of Mt. Fuji.

We also see in the same table that in the so-called non-growing season, i.e. in the winter, the air on the north side is rather humid, but in the spring and summer the air is comparatively dry. The evergreen conifers are as susceptible to the effect of humidity in winter as in summer. But in the growing season, they have comparatively a smaller leaf-surface for evaporation than the broad-leaved trees. They are, therefore, less in danger than the broad-leaved trees, if the air is dry during the growing season. In short, the conifers can stand comparatively dry air in the growing season, but they can not stand much drier air in winter. Therefore, the conifers do well in a region where the air is comparatively moist in winter, and dry in spring and summer. This we see in the table is the case with the region on the northern side of Mt. Fuji.

As we have already stated, the variation of temperature and rainfall can give but a vague explanation of the contrasting features of the forest regions on the different sides. But a careful examination of the effects of humidity shows that it is a most important cause of the differences in growth which are characteristic of the several flanks.

Here let me refer again to the relation which the deciduous and evergreen trees bear to the water-holding capacity of rocks. The

same reason which we have just discovered in the case of the humidity, explains why it is that the evergreen conifer shows a preference for rocks, particularly lava-streams, which possess greater water-holding capacity and in this respect show smaller fluctuation in the different seasons of the year. On the contrary, rocks, possibly like detritus or waste, and the ejectmenta consisting of sand or lapilli, exhibit smaller water-holding capacity and even this is subject to greater fluctuation.

d) Sunshine

Next let us consider the differences in the duration of sunshine on the different sides. Granting that the observations at the Kōfu station will answer for those of the northern side of Mt. Fuji, and the observations at the Numazu station, for those of the southern side of the mountain, the possible duration of sunshine on both sides is shown in the following table:

Months / Sides	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann'l
Kōfu, northern side	311	305	370	392	435	434	442	416	370	348	308	301	4432
Numadzu, southern side	312	306	370	391	433	432	440	415	370	346	309	304	4431

The following table shows the actual duration of sunshine at the two stations.

Months / Sides	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann'l
Kōfu, northern side	180	202	202	185	210	195	154	222	171	155	173	198	2246
Numadzu, southern side	185	187	186	190	226	192	191	235	180	172	181	203	2306

Ratios of possible durations to actual durations on both sides are shown in the following table.

Months / Sides	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann'l
Kōfu, northern side	58	66	55	47	49	45	35	53	46	45	56	66	52
Numadzu, southern side	59	61	50	48	48	44	45	56	48	49	59	67	53

Upon considering the foregoing tables, we find that throughout the year the weather is better on the southern side than on the northern. But it should be stated that in February and March the

weather is better on the northern side than on the southern. This fact will at least favour the conifers which have ever-green leaves even in the cold winter and thus have power to do starch-building even then; but will not benefit deciduous trees which have no leaves to enjoy the sunshine.

e) Wind-direction

It is true that the wind plays a somewhat important part in forest making. The fact is that the gentler the wind the better it is for the forest, and accordingly the velocity of the wind is an important factor. We have, however, no information about the wind velocity at the base of the mountain. Setting it aside, therefore, let us proceed to examine the direction of the wind.

As the wind plays an important part in conveying plant seeds to a distance, the discussion of the wind-direction will throw some light upon the questions whence and how plants were first brought to this volcano. The wind-direction at the different stations is given in the following table.

Months / Stations	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ann'l
Shiraito	N	N	N	SE	SE	SE	SE	SE	N	N	N	N	SE
Ōmiya	S	S	S	S	S	S	S	S	S	S	S	S	S
Goten	S	S	S	S	S	S	S	S	S	S	S	S	S
Nakano	W	W	SW	S	S	S	S	S	S	S	S	SW	SW
Shoji	N	N	SE	SE	SE	SE	SE	SE	S	S	S	N	SE

As the mountain lies in the so-called monsoon region, northerly winds prevail in the winter, and southerly winds in the summer. But in the region under consideration the direction of the wind is somewhat changed owing to the neighbouring high mountains. Thus the prevailing wind throughout the year is the south wind.

As previously stated, the mountain must have been entirely bare until it entered the extinct phase. After having become ready to give plants their stands, it must have received its first inhabitants from the neighbouring mountains. In the course of my observations I have come to believe that the winds and the birds were the only possible agencies for conveying plant-seeds to the mountain. The wind must, therefore, play an important rôle in making up the flora of Mt. Fuji.

Fig. 13. *Polygonum* formation; consisting of *Polygonum cuspidatum* and *Polygonum alpinum* var. *japonicum*, at the altitude of 2500 m. on the southern side, on the western edge of the depression, from the bottom of which abruptly rises the Hoyé monticule. The western flank of the monticule is seen in the background. Phot. B. HAYATA, July 1924.

Here we must not forget to mention that in the middle layer of the air the constant wind is that from the southwest. In the case of Mt. Fuji, therefore, at the 2500 m. elevation, the south-westerly wind prevails. It is only from southern mountains that the peak could have received alpine plants, and looking on the map we see that there are no high mountains on the south. In other words, there is no elevation on the south that is high enough to contribute alpine elements to the vegetation of Mt. Fuji. This fact must go far towards explaining why the flora of the mountain is so poor in alpine elements; for example, *Pinus pumila*, so common in alpine regions in Japan, is entirely wanting on this mountain.

IV. SUCCESSION OF VEGETATION, TIME BEING CONSIDERED AS ONE OF THE CONTROLLING FACTORS

Thus far, I have endeavoured to explain, as far as possible, the vegetation of the present time and its controlling factors. There are still many things which lie far beyond our explanation. They belong to what ecologists call the succession of vegetation, in the discussion of which, I believe, time must in any case be taken into consideration.

Now, let us assume that a front plane represents the present state, and a rear plane, the former state of vegetation (which can never actually be seen, but which can be imagined from data known to us) and the interspace between the two planes, the space of time between the two states of vegetation. Then the hexahedron bounded by the two planes front and rear, should represent the vegetation displaying all the changes that have taken place from the former up to the present time, or in other words the succession of vegetation within the space of time. Keeping this assumption in mind, we shall consider the vegetation thus to be compared to a hexahedron.

We have already discussed the vegetation at the present time, comparable so to speak to the front face of the hexahedron. Now arises the question, What may the former vegetation, comparable to the rear, have heen like? Imagine the very beginning of the vegetable world of Mt. Fuji. As it was formerly an active volcano, there can be no doubt but that it must have been in its earlier period entirely destitute of plants. Then the mountain after some time became extinct and was given a vegetation, consisting, at first, of

mosses and lichens, and then, of grasses and herbs, somewhat similar to the vegetation shown in fig. 13. How this poor vegetation gradually led up to the present luxuriant growth, wo do not clearly understand. Yet, there is something in the present which enables us to thread our way through the chaos of the past. We see in one place that grassy or herbaceous formations have already been turned into shrubberies, and in another that thickets are in their turn about to be replaced by forests. So far as my observation extends, plant-formations do not remain constant through all time, but change from generation to generation. A few examples will illustrate this fact.

1) Birch-forest being replaced by evergreen conifers

On the western side of Komitaké, at the altitude of 1,900 m. there is a fine broad-leaved forest principally composed of several kinds of *Betula* (fig. 14) surrounded by evergreen conifer, *Tsuga diversifolia*, constituting nearly pure stands. In this birch wood, neither birch sapling nor young tree is to be found to replace the forest, but there is an abundant growth of young trees or saplings of *Tsuga diversifolia*, *Abies Veitchii* and *Larix leptolepis*. It is, therefore, evident that the present formation composed of birch will be replaced by conifers after some time, say fifty years.

2) Larch-forest being replaced by spruce

A little above the same place, at the altitude ef 2,100 m. there is along a valley a fine, nearly pure, stand of *Larix leptolepis*. In the shade of this forest, we find no larch saplings, but a great number of young trees of *Abies Veitchii* and *Tsuga diversifolia*. Here, again, we see clearly that these larches will in time be succeeded by the evergreen conifers. Another case of the succession of the same type is seen on the upper flank above Mizugatsuka, where *Larix leptolepis* is gradually being replaced by *Picea ezoënsis* (fig. 15).

3) Hemlock-spruce giving way to white fir

On all sides of the volcano, at the altitude of 2,000 m., there is found a wonderful growth of nearly pure stands of *Tsuga diversifolia* (fig. 16). Curiously enough, we find only a very few of the young trees of the same conifer, and those rarely ; but very often and in large numbers, saplings of *Abies Veitchii*. What will become of the growth wonderfully luxuriant at the present time, but without descendants for the future, we shall see presently.

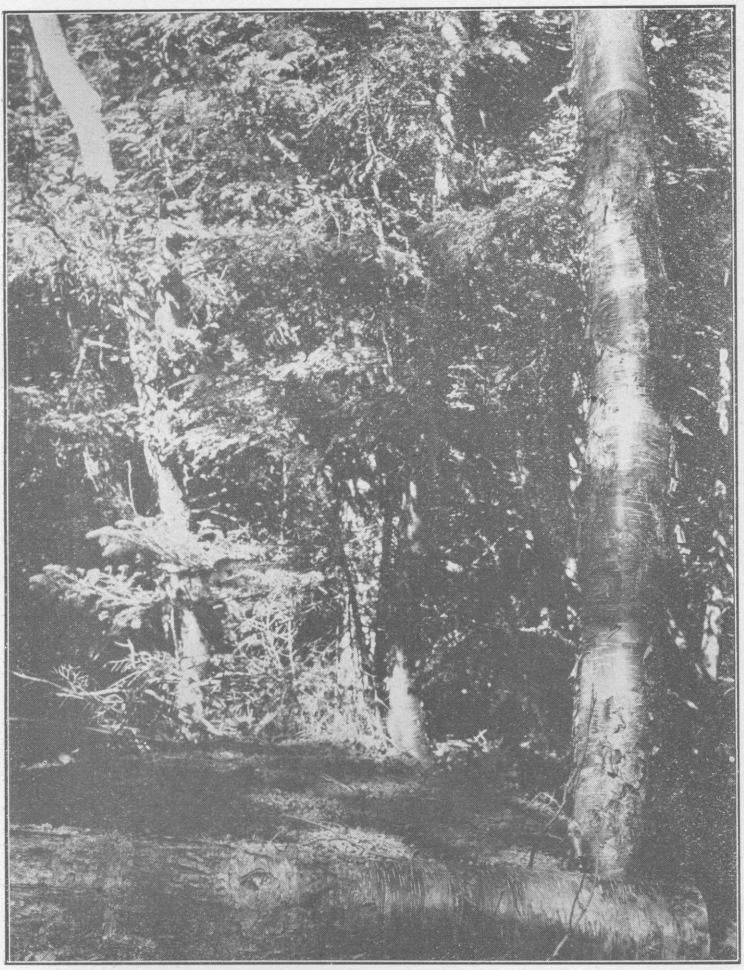


Fig. 14. Forest of *Betula* spp., at the altitude of 1900 m. beside the path up Mt. Fuji from Shōji. In the shade of this forest, young trees of *Tsuga diversifolia* abound in large numbers. Phot. B. HAYATA, Aug. 1924.

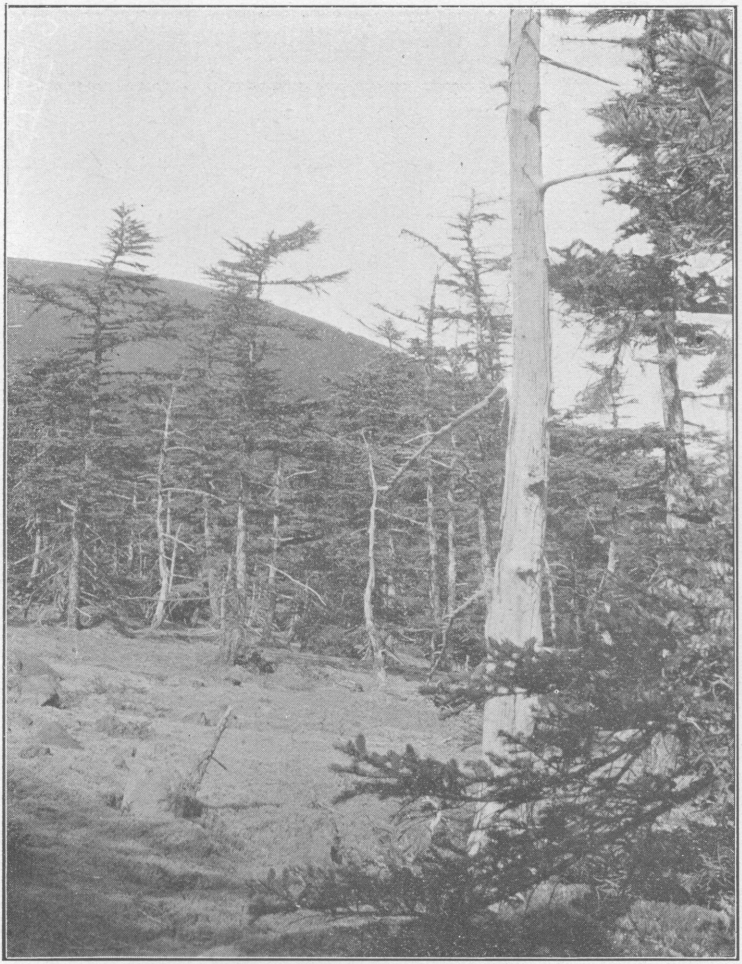


Fig. 15. Stands of *larix leptolepis* at the altitude of 2200 m. on the western (left) side at the head of the Rokubugawara near Mizugatsuka. The *Larix* is about to be replaced by *Picea ezoënsis* which is seen in the foreground on the right; many of the larch already show symptoms of senility and some of them are standing dead. The southern half of one of the Nishifutatsuzuka is seen in the background. The grayish white carpet, soft and thick like a cushion, in the foreground is a dense formation of *Cladonia sylvatica* HOFFM. Phot. B. HAYATA, July 1924, (E. VII.).

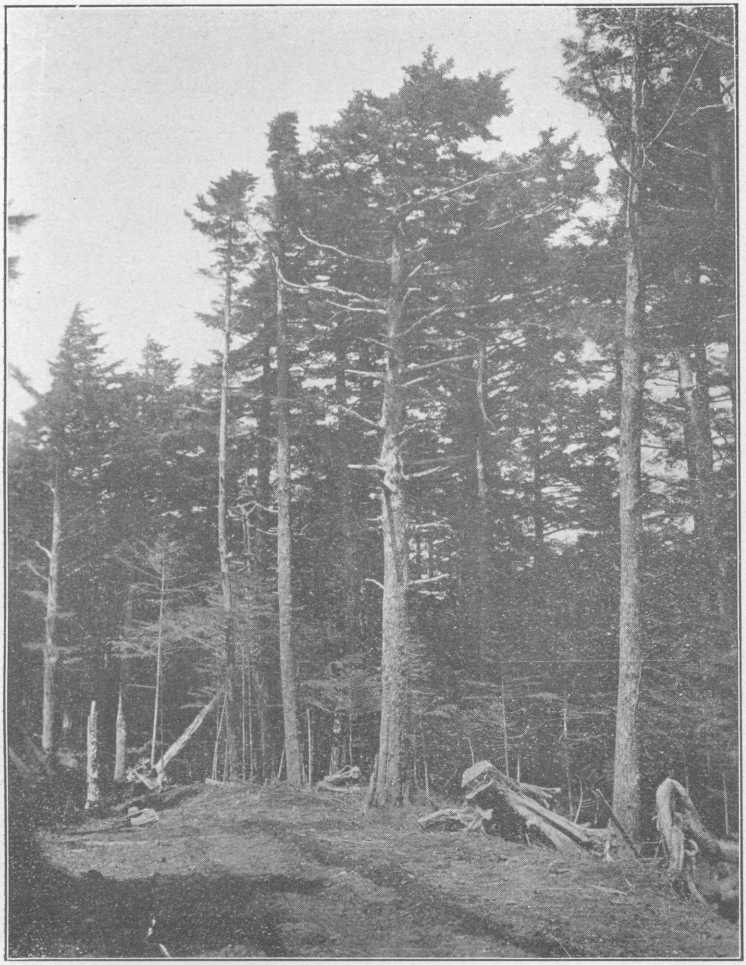


Fig. 16. Pure stand of *Tsuga diversifolia*, at the altitude of 1850 m. by the side of the path up Mt. Fuji from Shōji. The *Tsuga* has already passed its prime. In the shade of the forest there are seen large numbers of young trees of *Abies Veitchii*. Phot. B. HAYATA, May, 1924 (A. VI.).

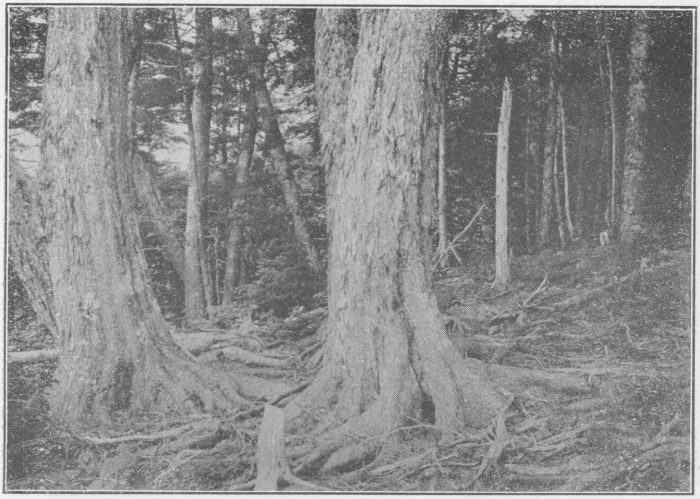


Fig. 17. Pure stand of *Tsuga diversifolia* in a district called Ōshima at the altitude of 2200 m., on the southern side. This hemlock spruce already shows symptoms of senility and is becoming very shallow rooted. Photographed by B. HAYATA, July 1924 HV or KVIII.).

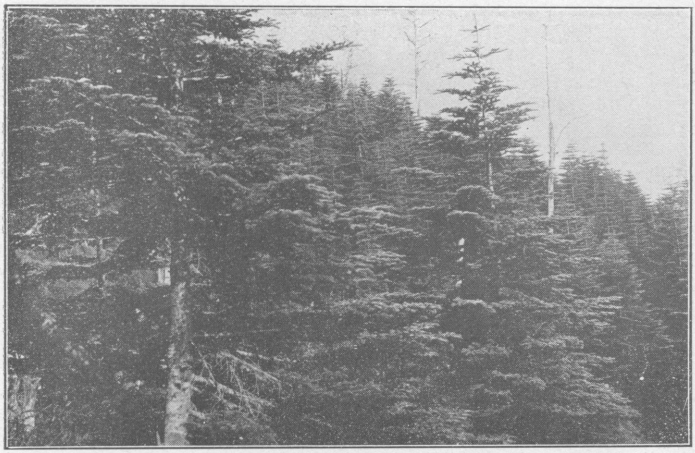


Fig. 18. Secondary formation, consisting of a pure stand of *Abies Veitchii*, at an altitude of 1900 m. above Takabachiyama on the southern side, bearing some evidences which suggest its establishment on the site of a forest of *Tsuga diversifolia* destroyed by fire. Phot. B. HAYATA. July 1924 (K. XI.).

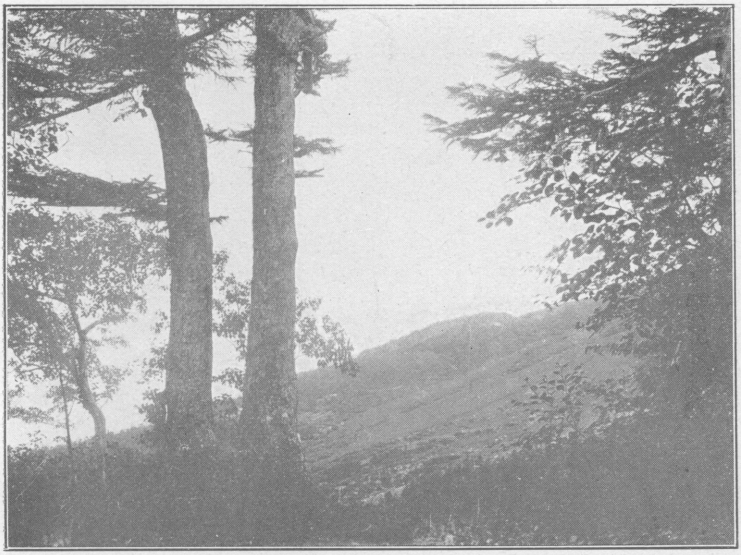


Fig. 19. View of a mountain ridge in the background called Hosono o at the altitude of 2400. on the northern side. Behind this mountain ridge is another ridge called Kurouné where the succession of *Larix leptolepis* to *Abies Veitchii* may be observed. Several kinds of *Alnus*, *Betula* and *Sorbus* are seen in the foreground. A path winding about the middle height of the cone, is faintly seen crossing "Okawara," a bare patch above the head of Kawarabori. Phot. B. HAYATA, Aug. 1924.

The natural life of this hemlock-spruce is estimated to be as long as from two to three hundred years. When it attains to an advanced age, it presents evidences of senility (fig. 17). It comes to have shallower roots, and is likely to be easily blown down in a storm. I have seen, on the lower slope of Komitaké and on the upper flank on the Yamanaka side, several tracts where a fine forest of the *Tsuga* has been totally destroyed by a whirl wind. Never have we seen even a single case where the forest after suffering such a blow has been directly restored with the same tree. We often find that on such a site a new forest mainly consisting of *Abies Veitchii* has been established (fig. 18). What then will be the fate of the new stand thus formed?

4) White fir being replaced by larch

Abies Veitchii lives rather a short life and in keeping with this nature, it is most prolific. It is found everywhere forming a new stand at altitudes of 2,000 m.—2,300 m. In the forest of this white fir, we find in one case young trees of the same fir, but in another, saplings of *Larix leptolepis*, *Tsuga diversifolia* or *Picea ezoënsis*. We may be justified in inferring that the stands of the *Abies* may be continued for some generations, and yet that sooner or later the time will come when they will give way to some other kind of conifer. The most remarkable case where the fir is about to be replaced by a larch, *Larix leptolepis*, is seen in a tract called "Kurouné" between the Takizawabori and the Namebori at an altitude of nearly 2,300 m. (fig. 19). There the firs already show symptoms of senility, and undoubtedly have come to their natural end. Most of them are dying a standing death, while under these old firs adolescent larches are growing vigorously. The larch is, generally speaking, a comparatively light-loving plant, less able to endure shade than any other conifer. It is certain that shade is more tolerable to the fir than to the larch. It is, therefore, quite natural that the former should invade the shade of the latter, and we find this to be usually the case on Mt. Fuji, and this in turn should be supplanted by another, more tolerant of shade than the fir itself. But here we see the case altogether reversed. It seems, therefore, that tolerance of shade, together with other conditions, has but little significance, when successive formations are compared, that is to say, that in time when it must be replaced by another, it will be so replaced, irrespective of what the succeeding growth may be.

5) Broad-leaved trees being replaced by evergreen conifers

The successive occurrence of broad leaved trees and conifers is to be seen in the lower forest region at an altitude of nearly 1,000 m. In the eleventh division in the region of broad-leaved trees on the western flank and also in a place near Akatsuka in the same region, there are several tracts where broad-leaved trees are giving way to evergreen conifers, such as *Abies firma* or *A. homolepis*.

6) Alders giving way to larch

Moreover, there are many places where clumps of alders commonly found along valleys are about to be replaced by forests of larches (fig. 20 and 21).

7) Cases suggesting the periodic rise and fall of dwarf bamboos

A very interesting and everywhere familiar case is also to be seen in the formations of dwarf bamboos on Mt. Fuji. Their general distribution has been already considered and the probable relation which bamboos bear to rocks has been stated. Yet, there are many cases which seem entirely to ignore such a relation. I shall give here some of the most remarkable instances. As can be seen in the botanical map annexed, the abundant growth of dwarf bamboos, extending from the southern flank to the western, forms a nearly semicircular belt. We find, however, a large gap measuring 3 km. in breadth on the south-western portion of the otherwise continuous band. The rocks and soils on both sides of the gap are very similar to those in the gap itself. When, in August, 1924, I passed this place where I found the same kind of forest, I was greatly struck with this singular distribution. There outside of the gap my way was quire obstructed by a dense impenetrable thicket of bamboos but here in the gap I found none at all. I brought back a handful of each of the soils, within and outside of the gap and had them analysed. They presented no distinction whatever either physically or chemically. To none of these controlling factors is this discrepancy to be attributed. Periodic rise and fall must, therefore, be taken into consideration.

The ejectmenta of sand or lapilli on all the parasitic cones seem very similar. Yet they are not clad alike with dwarf bamboos. Far from that, the vegetation on the monticules presents very different aspects with respect to the bamboos. On the one hand,

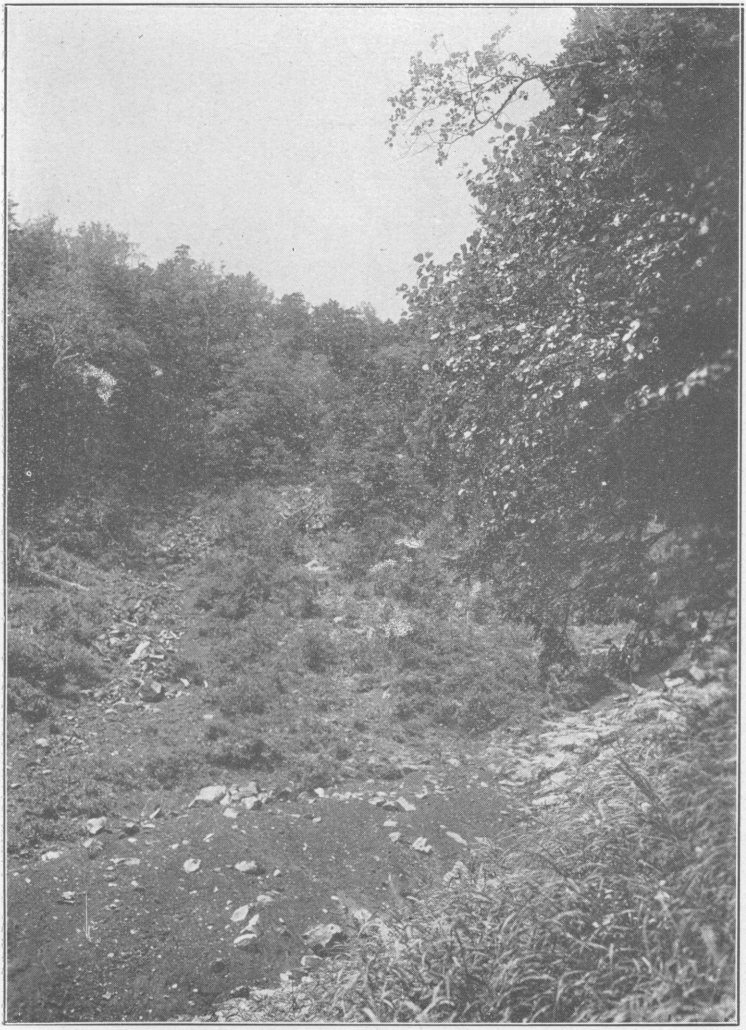


Fig. 20. Thickets along the upper part of the Aozawa at an altitude of 2100 m. on the southern side. On both sides of the valley, there are found thickets, consisting of several kinds of *Alnus* (mostly *A. Matsumurae* and *A. alnobetula* var. *fruticosa;* the emarginate leaves of the former species are clearly observable in the picture). Behind them, stands of *Larix leptolepis* are seen bearing some evidences suggesting the succession of the latter to the former. Phot. B. HAYATA. July 1924 (K. IX.).

Fig. 21. Inside the same thickets. Here we see the *Alnus* (*A. alnobetula* var. *fruticosa*) on the lower slope, and behind and a little above it some *Larix leptolepis*. Phot. B. HAYATA, July, 1924 (K. II.)

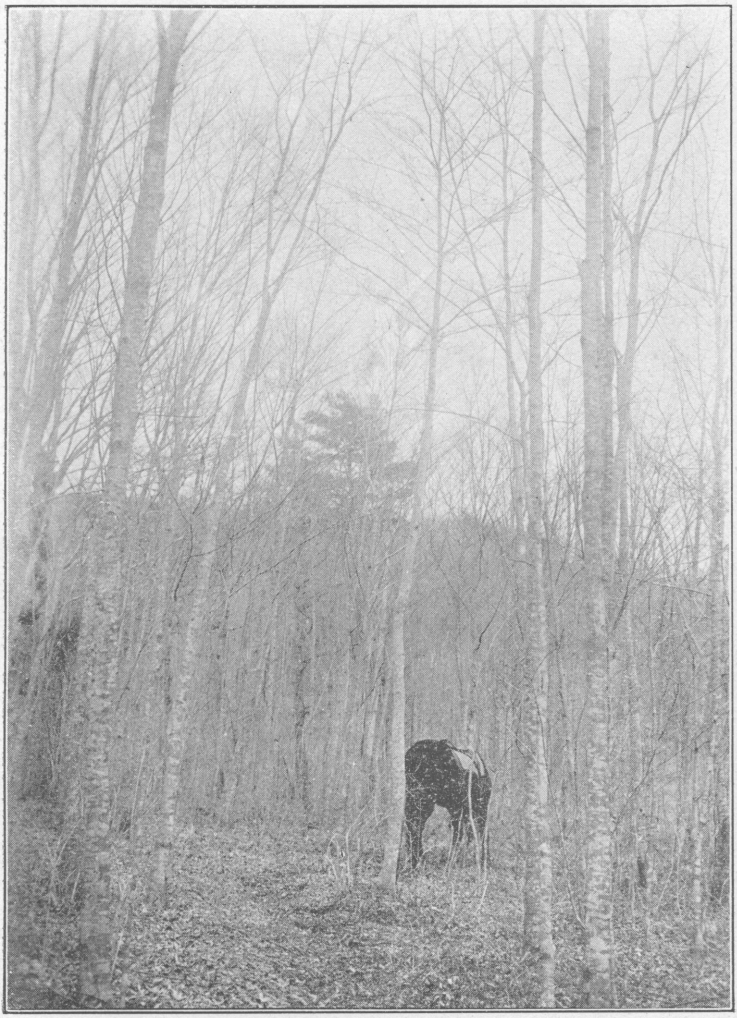


Fig. 22. Secondary formation, consisting of a pure stand of *Carpinus yedoensis* formed on the site of a forest of *Alnus incana*, cut down for firewood or other use. A single tree standing behind a dark chestnut horse is *Cornus controversa* and another at the center in the background is *Finus densiflora*, while all the rest are *Carpinus yedoensis*. Phot. B. HAYATA, March 1924, (E. VI.).

Jiroimonzuka, Hiratsuka, Asagizuka and Higashiusuzuka (all on the southern side); and Yumiizuka, Katabutayama and Futatsuyama (all on the north-western side), are all covered with sparse or dense thickets of several kinds of dwarf bamboo, mostly *Sasa borealis;* but, on the other, Kofuji (on the eastern side); Maruyama and Komitaké (both on the northern side); Nagaoyama and Omuroyama (both on the north-western side); and Nishiusuzuka and Shiratsuka (both on the south-western side), are entirely free of any kind of bamboo.

The periodic rise and fall of the bamboo is so well known a fact that it is hardly necessary to discuss it here.

8) Alders being replaced by hornbeams

The replacement of alders by hornbeams on a tertiary hill by the side of Lake Yamanaka is a well-known fact. Here, on this hill, if the land is left uncultivated, there is found a fine forest of an Alder, *Alnus incana*, quite spontaneously established in ten to twenty years, as this alder grows rapidly. Cut the forest down for firewood or other use, and after a certain time we shall undoubtedly see the formation of a new forest of a hornbeam, *Carpinus yedoensis*. A fine example of a forest of *Carpinus* thus formed, is shown in the accompanying photograph (fig. 22). What we shall find on the site of the latter forest when it has been cleared, nobody knows exactly, as the hornbeams long outlive the man who would study them. Some say it is *Zelkowa acuminata* that takes the place of *Carpinus yedoensis*, but others doubt this. I have never seen a wood of the *Zelkowa* which would suggest its establishment after this fashion.

9) Forest of *Picea polita* approaching its natural end

Finally, I will mention one more case. In the grand pure stand of *Picea polita* on the Takamarubi, the young trees of this species are rather rare, while those of *Tsuga Sieboldi* are abundant. One part of this forest was formerly destroyed by fire. In this part we now see red pines making their way, but no new stand of the same spruce. The average age of the spruce is about two hundred years, as I have ascertained by counting the annual rings on the stumps left on the site of the former forest destroyed by fire. Although the trees in this forest do not as yet show any signs of senility, they already seem far past the prime of life and to be approaching their natural end. There, as I have said above, the young trees of the succeeding generation of *Picea polita* are rather rare. It is said that some time

ago the people put on a layer of new soil over some parts in the forest in order to enable the falling seeds, which are here produced in profusion, to germinate and to produce seedlings. But this scheme entirely failed and we could find no more young trees on the new soil, than on the old ground. I have never made such an experiment; but, when I was told this story, the thought immediately occurred to me that, in that declining period, the seeds had lost the power of germinating. Thus there seems to be no way of maintaining the same kind of a forest through many generations.

Should all forms of life share the same fate as this *Picea polita*, and prosper only to decline in the end, things should be greatly different from what we have been taught by the theory of natural selection due to the struggle for life.

10) Conclusion

The succession of vegetation which we have illustrated thus far, has been attributed to several causes, most of which, however, are of the hypothetical kind, like that which we call "Iyachi", i.e. the tendency of plants to come to dislike the same locality in course of time. Here, I am not going into detail, yet let me state this much, viz., that no matter what the species may be, the result is always that the one now occupying a place will be replaced by another in future. The formation which we see at present is after all but a single scene, as it were, in the great drama of plant-succession. Now, let us see some of the things which I believe Mt. Fuji will teach us in our two days' excursion to the mountain.

V. EXCURSION TO MT. FUJI

1) From Gotemba to Kagosaka Pass

First day. Leaving Tōkyō in the morning we find ourselves about noon at the Gotemba station. Here we obtain a full view of eastern side of Mt. Fuji. This is just one quarter of the whole area which belongs to the mountain. The wide skirt which stretches near and far over a score of miles is, roughly speaking, bordered by the Hakone range on the east, by the Ashitaka on the south, and by the Kagosaka on the north (fig. 23). Far to the south in the basal region, we see the range of Ashitaka, an extinct volcano, clad with deciduous broad-leaved trees. There a little higher is seen a rather

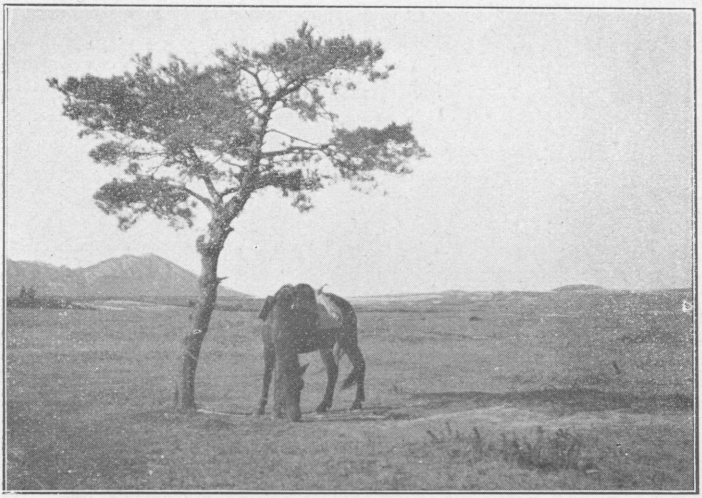


Fig. 23. Grass-region on the south-eastern side seen from Takigahara. Mt. Ashitaka on the left; a small flat rounded mound, Kansuyama, on the right side, and another, Hiratsuka, near the center, both clad with dwarf bamboos. Phot. B. HAYATA, March 13, 1924.

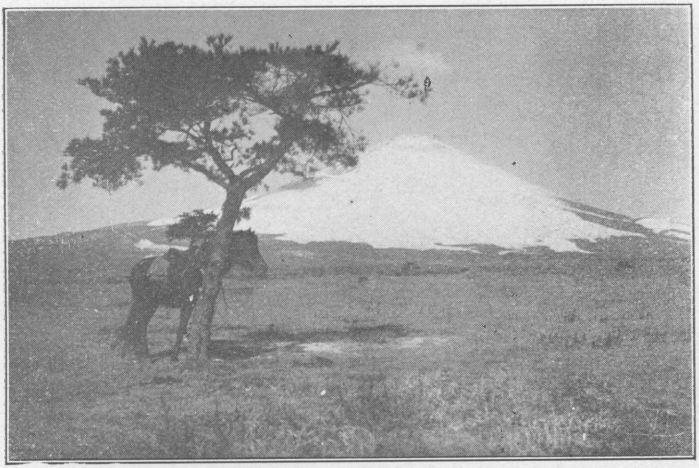


Fig. 24. View of Mt. Fuji, seen from Takigahara, the Kofuji monticule is seen on the extreme right shoulder of the cone. Phot. B. HAYATA, March. 14, 1924.

small and very rounded hill, which might easily pass for a shell-mound. It is one of the numerous monticules which the mountain has around its base, and which we shall meet with one after another, as we proceed on our trip around. These parasitic cones are interesting on account of the fact that each one of them possesses a nearly peculiar vegetation, and especially this one. It is called Hiratsuka (literally "flat mound"). At a distance it appears uniformly green, even at this season of the year when the basal grassy region around has all turned to a brownish yellow. The monticule owes its green colour to a pure stand of dwarf bamboo, called *Sasa hiratsukensis*, which densely covers the entire hill (figs. 10, 23 and 27).

Now, we shall proceed northwestwards, and presently we come to a place called Mizushino where we find a fine row of red pines. We have ascended slightly. The lower grass region is almost hidden. An immense deciduous broad-leaved forest now stretches before our eyes. To the west, we observe many parasitic cones, extending as far as the eye can reach. Below toward the foot, we notice Hiratsuka in the lowest region; a little higher, another parasitic cone called Kansuyama (figs. 23 and 27) clad with deciduous trees; then a little higher still, Katabokko, a monticule half-crowned with a forest; again higher and farther away is Asagizuka, a cone covered by a dense broad-leaved forest with an admixture of evergreen conifers. A little nearer to us, between Katabboko and Asagizuka, we notice another parasitic cone clad with trees on this side, but with dwarf bamboos on the other. It is called Jiroyemonzuka. Just in front of that monticule, we notice a grassy tract of light brown color, bordering the foot of the hill. It is the upper prolongation of the broadest plain, called Ōhnohara, which extends for a distance of ten miles and as low as to the 300 m. level, which plain we have already seen below Hiratsuka.

In the forest region now extending before our eyes we notice a beautiful growth of pines which is most densely formed towards the north, but becomes thinner and thinner towards the south till it ends near Akatsuka. Higher up dark green conifer forests composed principally of *Abies*, *Picea* and *Tsuga* are seen on both sides, but are nearly wanting in the front part. Far above the forest regions, we see a formation bordering the upper bare part of the truncated cone; it is uniformly coloured a rosy brown, and is very irregular in its outline. It is the higher grass region consisting mainly of *Miscanthus*

Matsumurae. Turning our attention to the right side, we notice a quite bald monticule surrounded by dense forests of evergreen conifers. It is called Kofuji. (fig. 24). Above and on the left of the cone, there is a dense formation of *Larix leptolepis* which ascends far upwards as high as to the 2500 m. line. This we recognize at once by its peculiar autumnal coloration.

By the side of the path, we had noticed such deciduous trees as *Acer, Fagus, Prunus* and *Quercus*, each showing its peculiar autumnal tint. The maples are especially attractive, their bright scarlet glowing against the dark green of the *Cryptomeria*. The fruits of *Smilax China, Ilex Sieboldiana* and several species of *Viburnum* also add touches of a beautiful red. Perhaps, the most glowing tint is furnished by the crimson-lake in the foliage of *Rhus trichocarpa*, and the next most beautiful is that of *R. semialata*. The white panicles of *Hydrangea paniculata*, and the blue racemes of *Aconitum Fischeri* are also fine. As we proceed northwestwards, we pass through the small village of Subashiri. Just as we leave there we pass some fine *Cryptomerias* in the precincts of the Asama-Shrine.

Now we are approaching Kagosaka Pass and are half-way up the climb to it. Looking to the south, we see an immense expanse of red-pine forests (fig. 25). On the left shoulder of the truncated cone, just below the snow-clad cap, is Hoyé, the largest of the monticules, and further down two parasitic cones, standing side by side, called Futatsuzuka (literally twin mounds) (fig. 26). All the other parasitic cones, that we have just observed lie near the sky-line made by this same shoulder of the mountain (fig. 27). Here, on this side, the upper forest region is all occupied by the larch. Beside the path, we see the giant *Cirsium, C. purpratum*, with its single large nodding head. *Chrysanthemum sinense* with its numerous blue flowers is most abundant. *Polygonum cuspidatum, Cirsium spicatum, Vitis heterophylla* with dark purple berries, *Clematis heracleaefolia, Anemone cernua, Rosa fujisanensis* (fig. 28) with shining red fruits and *Lactuca denticulata* laden with yellow flowers are also met with.

Kagosaka Pass does not, in reality, belong to the volcano. It is on a range of the Tertiary formation, clad with ejectmenta from the parasitic cone of Kofuji.

2) From Kagosaka Pass to Yoshida

Having now reached the top of the pass, the grandest scenery of the northern side of the mountain is all at once spread before our

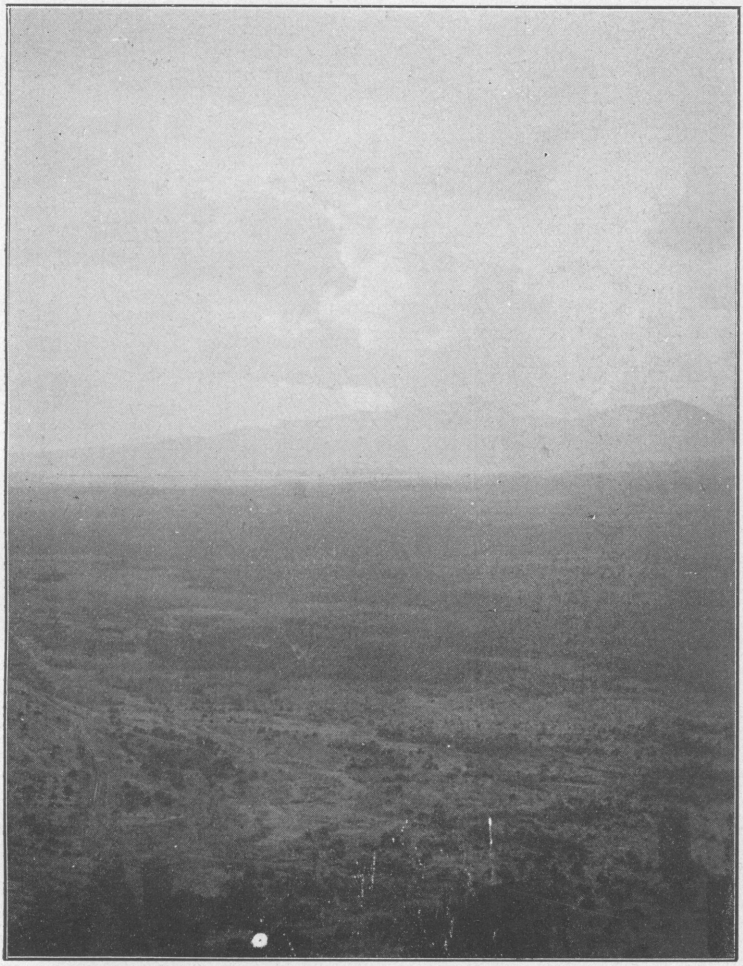


Fig. 25. View of the forest of *Pinus densiflora*, seen from a point half-way up Kagosaka Pass. Phot. B. HAYATA, Jan. 1925.

Fig. 26. View of Mt. Fuji, seen from a little south of the top of Kagosaka Pass; on the left shoulder of the cone, the Hoyé'monticule may be seen just below the snow cap, and some distance below it another cone, the upper of the twin cones called Futatsuzuka. Phot. B. HAYATA. Nov. 11, 1925.

Fig. 27. Distant view of several parasitic cones on the southeastern flank of Mt. Fuji, seen from a point a little south of the top of Kagosaka Pass. They are, in order beginning with the lowest, which in this picture seems to be at the foot of Mt. Ashitaka, Hiratsuka, Kansuyama, Akatsuka, Katabbo-ko, Asagizuka and Kotengu. Phot. B. HAYATA, Nov. 11, 1924.

eyes. Looking to the north we see at our feet the calm placid water of Lake Yamanaka or Hagetsuko (literally Half-Moon Lake) reflecting the pure blue autumnal sky. Eastwards we get a glimpse of a distant mountain called Yozukeyama, densely clad with deciduous broad-leaved forests with numerous outcrops of rocks of an ashy white colour. These exposures are due to a landslip which took place on a planted tract some years ago, as a result of too extensive and too reckless deforestation. Far to the northwest, we see the jagged mountains of the Misaka-range, bordering the opposite side of the lakes on the northern side of the volcano. But much nearer, and just opposite Lake Yamanaka, there is seen the low hill-range of Ōharayama. It is grassy on its upper slopes, but from the middle downwards is clad with a deciduous broad-leaved forest, composed of *Acer*, *Alnus*, *Carpinus*, *Fagus* and other trees. There, in this forest, we find the peculiar type of succession of vegetation to which we have already alluded.

Let us look backwards at the Kagosaka-range which we have just crossed. On our left on the hill called Mukō-kirizumé, we find, scattered through a dense deciduous forest, numerous stands of a huge conifer with dark green foliage, *Picea polita*, of which we shall presently see a wonderful forest.

As we descend toward the north, the view of the northeastern side of Mt. Fuji becomes fully unfolded. Here we find the flank to be greatly different from what we had seen on the eastern side, before we came over Kagosaka Pass. There, on the eastern side, the ground is rather new, owing to the eruption of the parasitic cone, Hōyé, and no remarkable valleys are to be seen; but here, on this side, everything is much older and is cut by a number of profound valleys, which we shall see one after another as we proceed farther north. On this, and also on the farther northern side, the deciduous broad-leaved zone is very poorly represented, while the evergreen coniferous zone makes the most luxuriant growth.

Now we are half-way down the pass, and see on both sides an afforestation of *Larix leptolepis*, and a little farther we come to the gentle slope, descending from the peak to the lake. Formerly this was an entirely treeless region, but now an afforestation of larches and red-pines is being carried out on a very large scale. The larch is doing well, but the pine looks miserable.

Thus we come down to the lake-side and meet with a deciduous

forest composed mainly of *Alnus*, *Carpinus*, *Quercus* and other trees. Looking now to the west and Mt. Fuji, we see that the cone on this side is very symmetrical, and the top perfectly truncated. On the southern side of the flank, a little below the middle, we see Hōyé just raising its brow above the shoulder of the cone, and to the north, Komitaké, probably a monticule the real character of which, however, has long been debated. Here we can see the zonal arrangement of different plant-formations according to altitudes. The *Larix*-formation is clearly displayed by its rosy brown colour. A little to the right of the middle we observe two big sylvan arms outstretched, consisting of pure stands of larch, along the Nagaredashi and the Takizawabori, and descending from the above formation down to the grassy plain. Between the *Larix* and the lower grass-formation, there is seen most distinctly a dark blue formation of evergreen conifers. This formation is most richly formed on this side. Directing our attention downwards we get a magnificent view of the gentle slope extending for miles. Notice the great variety of colors now unfolded before your eyes. Numerous dark-green patches of pines here and there dot the carpet of rosy brown clumps of deciduous trees on the lava-stream of Takamarubi.

Here, on this side of the volcano is an interesting formation which must not escape our attention. It is a forest of alders, with a few trees of *Abies homolepis*, at the foot of the western extremity of the Kagosaka-range (on our left), which forest takes the shape of a narrow boot with its toe towards the south and its heel towards the north. Another remarkable feature is seen in a horizontal row of young alders half way up the lower grass-region. This can be seen on our left side nearly half-way up, between us and the forest region.

At the end of the slope and by the lake, we come to a small hamlet called Yamanaka, sheltered in the forest. There we see a number of *Ligustrum* sp. laden with its black fruit. On leaving the village we again enter a deciduous forest, mainly composed of *Quercus crispula* on Takamarubi which descends from the middle of the peak, passing by Lake Yamanaka, and extends down as far as to Uchinomura nearly three miles away to the north. The breadth of the lava-stream that we have to cross here is about eight hundred meters.

We now go farther to the west and come to an extensive field, known by the name of Nashigahara, stretching far away with nothing

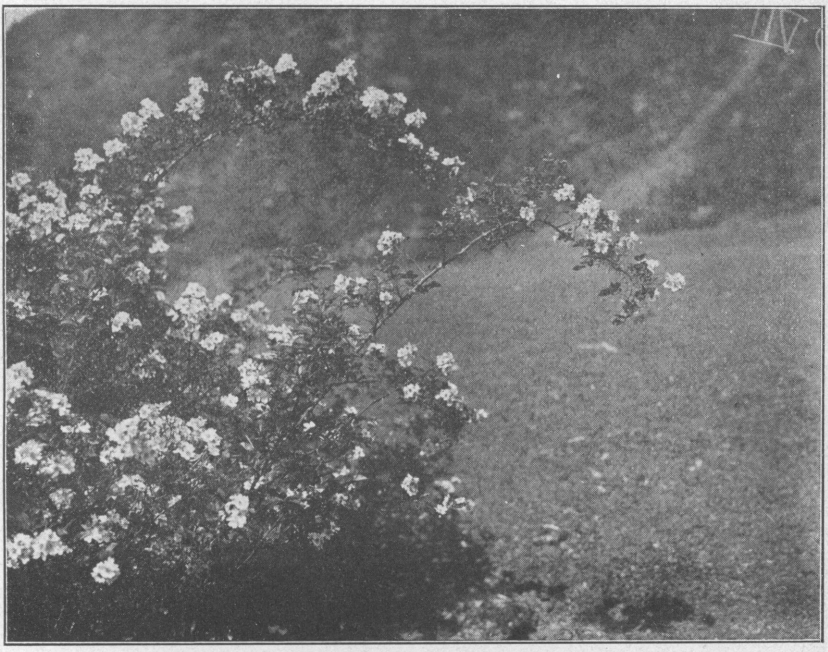


Fig. 28. *Rosa fujisanensis*, on the sandy ground immediately at the foot of Kagosaka Pass. Phot. B. HAYATA, July. 1924.

Fig. 29. Natural forest of *Pinus densiflora* of the Imperial Preserves, near the shrine of Fujitaké at Yoshida. Phot. B. HAYATA, May 19, 1924 BXI).

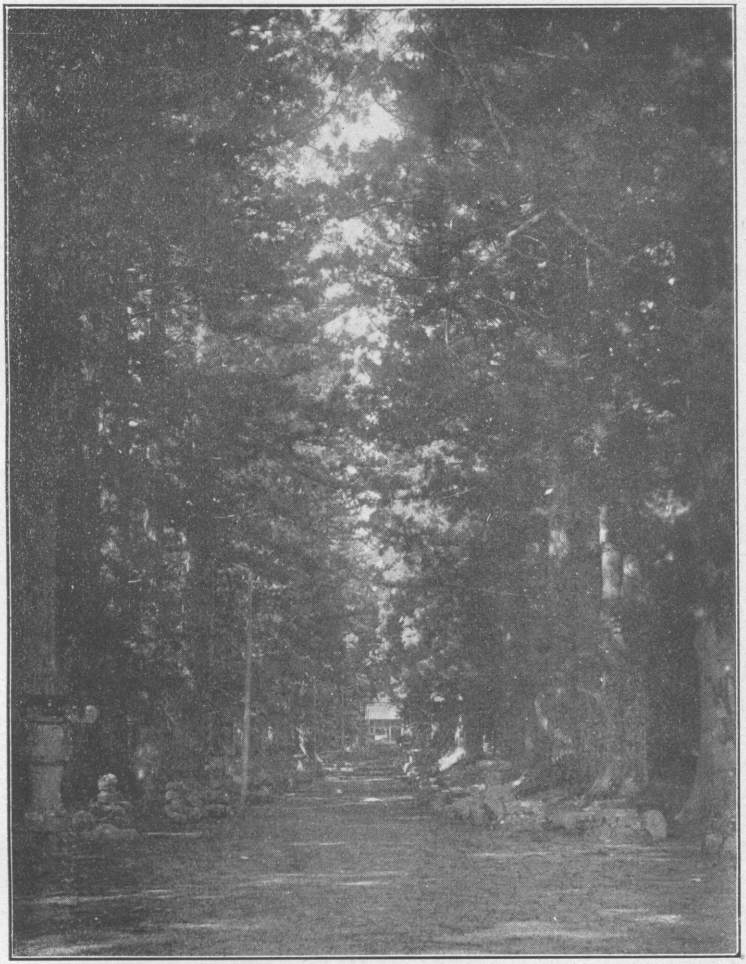


Fig. 30. Avenue of old *Cryptomeria japonica* in the grounds of the Fujitaké shrine; nearly all the stone lanterns along the approach to the shrine are lying where they were shaken down in the big earthquake of 1923. Phot. B. HAYATA, May 9, 1924, (B. VII).

to obstruct the view. Looking backwards and eastwards we get a full view of an immense and remarkable forest, consisting solely of a pure stand of *Picea polita* on the northern extremity of Takamarubi. This pure stand of spruce covers a triangular area measuring more than a square kilometer.

From here we cross Nashigahara and proceed through a clump of dwarf pines growing on the northern end of the Hinokimarubi lava-stream. Passing over a bridge we come to another lava-stream, called Tsuchimarubi, and thus arrive at the village of Araya. On the left, we have a distant view of an extensive forest of red pines belonging to the Imperial Preserves (fig. 29).

3) From Yoshida to Funatsu

Now we are near the small town of Yoshida. A short distance on this side of the town, we come to the shrine of Fujitaké with its beautiful grove of old *Cryptomeria* (fig. 30). Passing on through to the middle of the town and then turning abruptly to the left, we proceed directly west to Funatsu.

Presently we cross the Tsurugimarubi lava-stream, consisting wholly of blocks of a dark neutral tint (fig. 31). Let us go on a little and look back at the stream. The sight is most magnificent. From the upper boundary of the forest region on our right, the lava flowed straight down to the lower end of the same region, then bending a little eastwards at the foot of a parasitic cone, Maruyama, it cut diagonally through the gentle slope of the basal region from the west down to the east, retaining nearly the same breadth throughout its entire length, but expanding considerably at the basal end. Its upper extremity is occupied by evergreen conifers; a little below we find clumps of a larch which give way to those of a red pine towards the base. This is one of the longest of the lava-streams which were caused by the recent eruptions. The suffix "Marubi" added to their names distinguishes them from other lava-streams of a much older origin. By the western side of the upper end of Tsurugimarubi, we find another much shorter stream, called Demarubi. These two streams in their upper portions flow down side by side, but in their lower course nearly join a little below the forest region. Thence the longer descends eastwards, while the shorter turns to the west. On both sides of the streams, we see a number of tracts on which red pine afforestation is being carried out.

The view of the peak shows a large valley of the Kawarabori, just in the middle of this side of the cone, and cutting through the dark blue belt of evergreen conifers. Here, as in the case of the Takizawa-bori and the Nagaredashi, the larch predominates from top to bottom. Towards the west, the sylvan belt surrounding the middle of the cone tends to descend nearly to the base. This is principally due to the existence of another lava-stream, the Aokigaharamarubi, which we shall see presently. Westwards on the flank we see a number of parasitic cones (fig. 32). Beginning with the lowest at the edge of the skirt, their names in order are Omuroyama, Nagaoyama, Usuzuka, Kōsukeyama and Oniwa or Okuniwa. The last is not a single monticule, but a group of small cones, amounting as many as ten, disposed in two rows. The first, second and third parasitic cones are clad with a forest on the north side, but otherwise with grass. This is certainly due to the direction of the slopes, the wind and the sunshine. We shall return to this point later on.

4) From Funatsu to Gotenniwa

Meanwhile, we have reached Funatsu, and see a broad expanse of water before us. It is Lake Kawaguchi. Going due west, we pass the small village of Ōdawa, and arrive at another hamlet, called Narusawa. Here we notice very thick hedges of a yew, *Taxus cuspidata*, around each of the houses. This species is surely a native of Mt. Fuji, whence it must have been carried to other parts in some very remote times. The people can never tell us the history of the yew. Although quite common as hedges here and there at the foot of the volcano and so used for a very long time, it is seldom met with wild on the mountain. I know only a single example measuring three feet in diameter of the trunk; and a few rather poor trees, found wild on Mt. Fuji. We pass by the grove in the grounds of the shrine of Maōtenjin. There we see an example of a maple with compound leaves, *Acer nikoense*, a rather rare species in these regions.

At the end of the village we come upon a branch of the eastern end of the Aokigahara-lava. As we begin to cross it, we find on our right a fine forest of middle sized pines and on our left a dwarf clump of the same species (fig. 33). This difference is due simply to the former having been preserved, while the latter has been subjected from time to time to cutting for fir-wood. The undergrowth in these pine-formations consists mostly of *Ilex pedunculosa* and *Pieris japonica*.

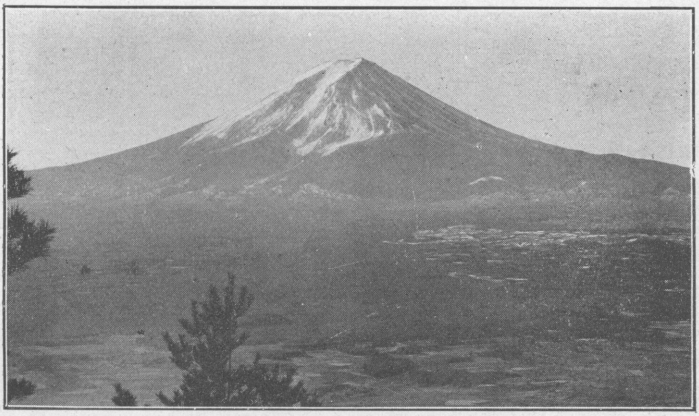


Fig. 31. View of Mt. Fuji seen from Usobukiyama to show the Tsurugimarubi lava-stream. Note the flow of the stream rushing, as it were, from the upper right to the lower left and stretching towards the arable plain of Funatsu; the Demarubi stream can be seen above on the right, but is hardly recognizable. Phot. B. HAYATA, Jan. 1925.

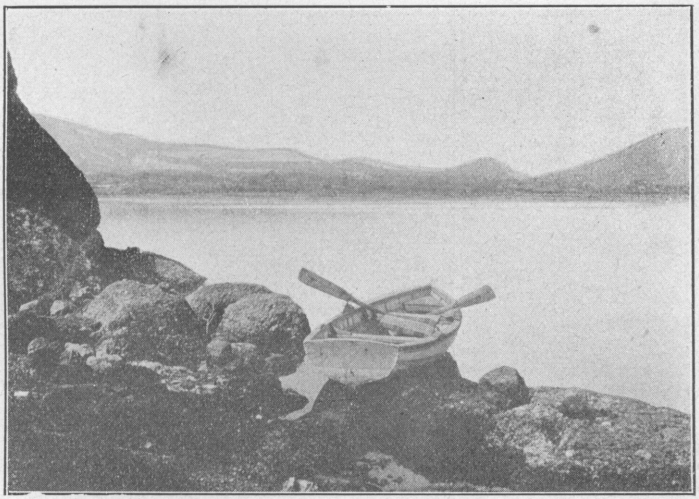


Fig. 32. View of Lake Kawaguchi. Several of the monticules on the western flank of Mt. Fuji are seen; to name them from left to right, they are Okuniwa, Kōsukeyama, Usuyama, Yumiizuka, Nagaoyama and Omuroyama. Phot. B. HAYATA, May 18, 1924 (B.V.).

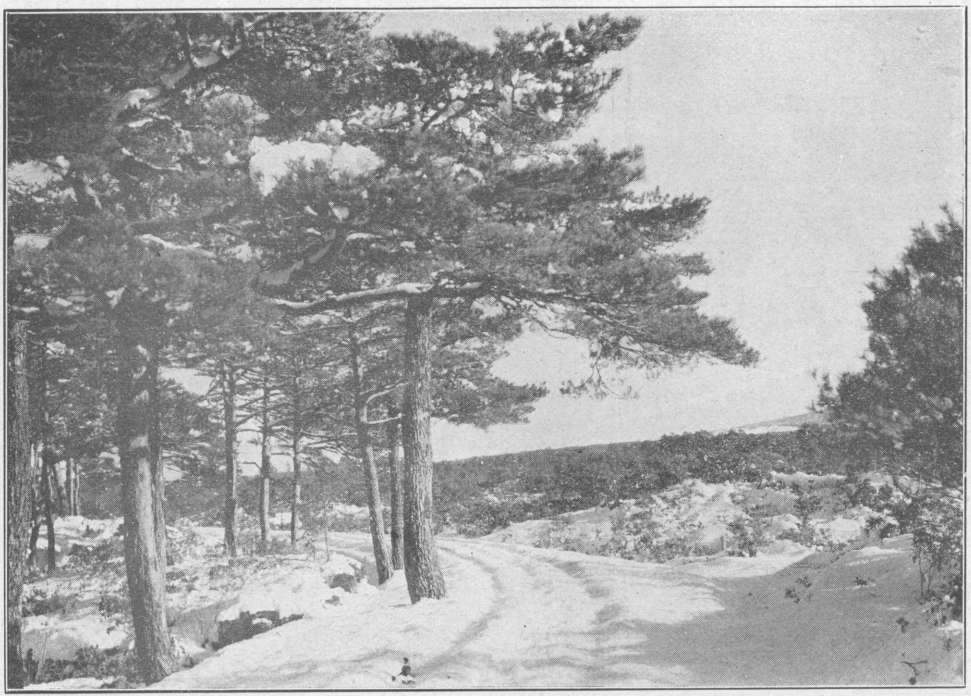


Fig. 33. Forests of *Pinus densiflora* on the eastern end of Aogigaharamarubi, looking back eastwards. The forest on the left side is preserved, while the clumps on the right have been cut for firewood. Phot. B. HAYATA, January, 1925.

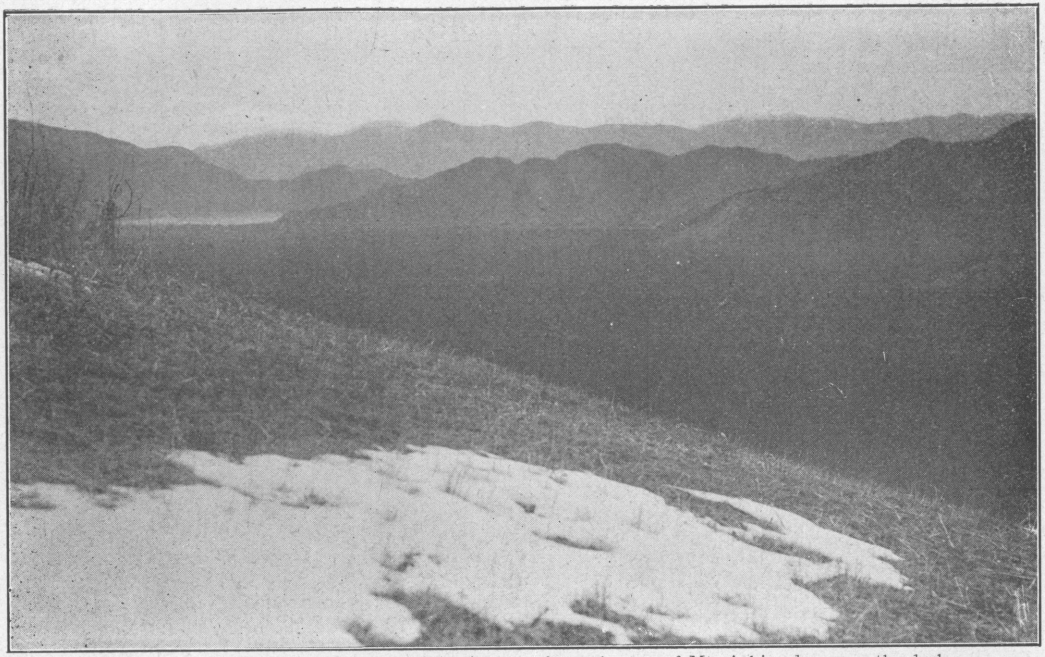


Fig. 34. View of the grand forest of Aogigahara from the top of Mt. Ashiwadayama; the dark blue wood, principally of *Tsuga Sieboldi*, stretches away like a sea. In the distance on the left is Lake Motosu, while Lake Shōji is hidden behind a promontory of Mt. Danwayama on the right. Phot. B. HAYATA, January, 1925.

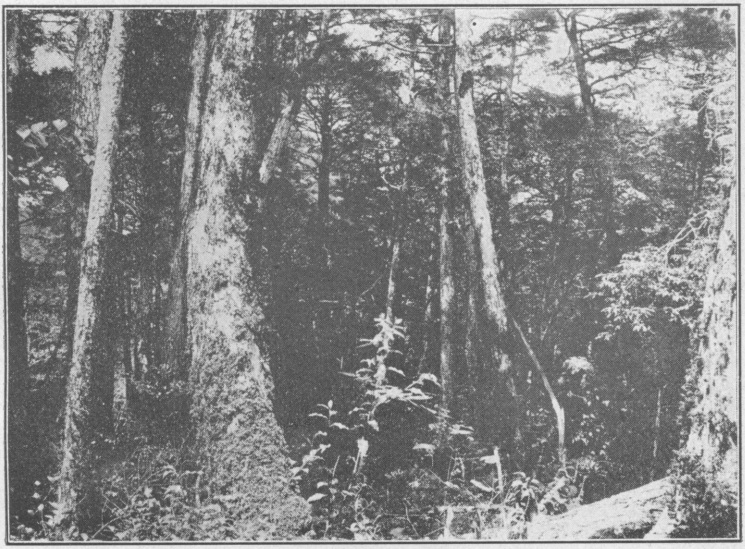


Fig. 35. Inside view of the forest of Aogigahara, consisting mainly of *Tsuga Sieboldi;* the chaffy bark so peculiar to the species is clearly shown in the photograph. Phot. B. HAYATA, Aug. 1925.

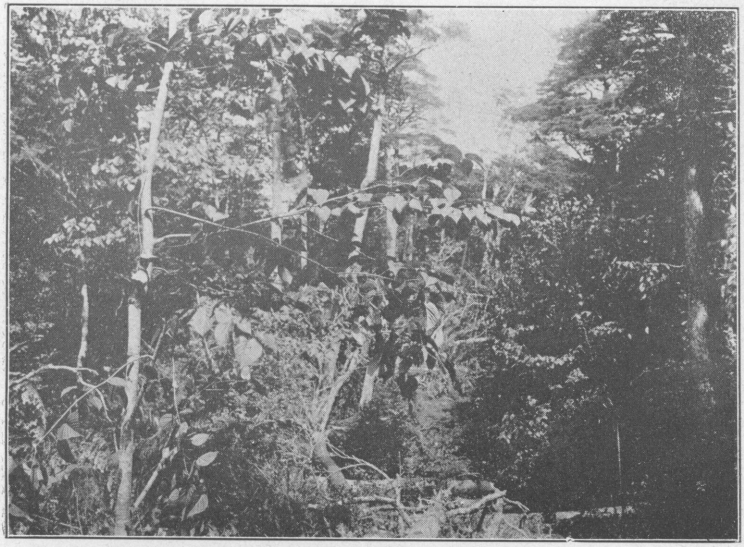


Fig. 36. *Acer distylum* in the forest of Aogigahara ; the trees with cordate leaves far and near are all of the same species, *A. distylum*. Phot. B. HAYATA, Aug. 1924 (DI).

Here, as in other places, the glowing autumn tints of *Rhus trichocarpa* look the most beautiful against the dark green of the evergreen undergrowth. Yellow flowers of *Lactuca denticulata* and scarlet tints of *Euphorbia pekinensis* are also worthy of mention. Passing over this branch of the lava-stream, we come to a flat hill of loamy soil, the origin of which is as yet undetermined. It is all covered by *Miscanthus*-formations. On the west, from this hill, there now comes into view a dark wood of conifers descending from far up in the upper flank down to the base, and thriving on the lava of the Aokigaharamarubi. Climb the hill on the right and look at the grand view of the evergreen conifers, stretching away like a smooth sea mile after mile of dark purple broken only by the mountain-range beyond (fig. 34). The scarlet tints of *Acer* and *Prunus*, and the yellow foliage of *Betula* make patches here and there among the conifers. The forest consists mainly of *Tsuga Sieboldi* (fig. 35), with some *Chamaecyparis obtusa*, *Picea polita*, *Abies homolepis* and *Pinus parviflora*. The latter pine is one of those which thrive better on the lava-streams than on any other kind of rock. The predominating undershrubs are *Ilex Sugeroki*, *I. pedunculosa* and *Pieris japonica*. Not far from the entrance of the forest we meet with a curious example of a tree growing on the trunk of another:—*Alnus firma* on *Chamaecyparis obtusa*. Presently we come to a clearing caused by fire. We see here clearly that the surrounding forests are nearly pure stands of *Tsuga Sieboldi*. The glowing tints of autumn presented by the maples are very attractive in contrast with the dark green foliage of the conifer. Of the maples to be found here, *Acer tenuifolium* presents the most beautiful scarlet, while *A. distylum* turns only to a pale yellow. The latter elsewhere a rare species is here found very abundantly (36). It has, unlike other maples, unlobed leaves. *Kalopanax sciadophylloides*, and *Kalopanax innovans* also display a pale yellow tint. The latter tree, of an otherwise rare kind like the unlobed maple, is here singularly numerous. It is easily recognizable by the existence of tuber-like protuberances on its trunk, by its ashy white bark and by its umbels of black berries. Other plants which contribute much to the variety of the autumn tints are *Acer nikoense*, *Euonyonus alata*, *Rhus taxicodendron*, *R. semialata*, *Prunus incisa* and *Vitis flexuosa*.

Not only the leaves but also several kinds of fruits give glory to the autumnal coloration. Panicles, cymes or racemes with a number

of small red drupes of *Meliosma myriantha*, *Viburnum erosum*, *V. furcatum*, *V. phlebotrycum* and *V. Wrightii*, *Sorbus sambucifolius*, *S. gracilis* and *Photinia villosa* may be mentioned as the most beautiful. The red winged capsule of *Euonymus macroptera*, on a very slender hanging pedicel, partly splitting into four valves, light purple on the back, with a few seeds wrapt in shining yellowish orange arils, is a thing which I have never passed without admiring its beautiful colouring. Another species of the spindle-tree, *E. oxyphylla*, bears a capsule of nearly the same kind, but this splits wholly into four or five fleshy wingless reflexed valves, crimson-lake inside, each with a single seed which is wrapt in a shining yellowish orange aril and hangs by a short slender thread from the apex of the valve. The much smaller, yet equally beautiful, capsule of another species of the same genus, *E. alata*, partially splitting by means of four valves which are reddish purple on the back, each with single or paired seeds at their apex, wrapt in carmine-red arils, is also worth looking at. Under the shade of the dark-green foliage, the bright shining scarlet drupes of *Ilex pedunculosa*, *I. Sugeroki* and *Skimmia japonica* seem every one more attractive than the last. Meanwhile we come nearer to the edge of the forest where the hemlock spruce is about to give way to the red pine. This place is called Gotenniwa* (fig. 37).

* There is another route westward from Funatsu and up to Gotenniwa by way of Lake Kawaguchi and Lake Saiko. Crossing the former by boat, we look at the surrounding mountain-range of Misaka, and find the hills already glowing with autumn tints. Soon we come to a small islet called "Bentenjima" (literally the islet of the goddess of beauty and eloquence). Towards the end of the lake, the scenery becomes more and more beautiful. On our left, we notice some old pines which seem to be reaching down to the water from the cliff (fig. 38).

Leaving the boat at Nagahama, we go up a gentle slope for half a kilometer. Then passing through a tunnel, we see all at once an expanse of water at our feet. It is Lake Saiko. Yonder, just on the opposite side, we see a nearly flat area clad with dark green conifers, sloping somewhat from south to north. It is the Aokigahara lava-stream. This coniferous forest extending over several miles consists principally of *Tsuga Sieboldi* with some amount of *Pinus densiflora*, *P. parviflora*, *Chamaecyparis obtusa* and *Abies homolepis*.

Again taking a boat, on our right, we see number of steep peaks clad with dark green conifers. They are collectively called the Jūnigatake. At Nemba, we bid farewell to Lake Saiko. Here, a full view of Mt. Fuji is obtainable. At the very base of the flank on the western side we see the large parasitic cone, Ōmuroyama, which we have seen before. Surrounded by evergreen conifers, this monticule is clad thickly with deciduous broad-leaved trees, mostly *Fagus*, *Ostrya* and *Quercus*. This variety in the forests on and around the parasitic cone is principally due to the different characters of the rocks.

As we go westwards from Nemba, we see on our left a natural forest of *Pinus densiflora*. This forest is located in the extreme northern part of Aokigahara. The pine predominates only near the edge of the forest on the lava-stream, while *Tsuga Sieboldi* occupies by far the largest area inside the margin. Now we enter the forest and find a multitude of the latter species. The ground consists solely of lava blocks. The undershrub found in the forest is mostly *Fieris japonica* with shining evergreen leaves and spikes of flower-buds which will open early next spring. Another predominating species is *Ilex pedunculosa* with its shining evergreen leaves and bright scarlet fruit. Meantime we come across a dwarf-pine formation on the dark gray lava blocks. The place is called Gotenniwa. Here occasionally we notice *Juniperus rigida* with its drooping branches.

Fig. 37. Forest of *Pinus densiflora* at Gotenniwa. Phot. B. HAYATA, Aug. 1924, (D-IV).

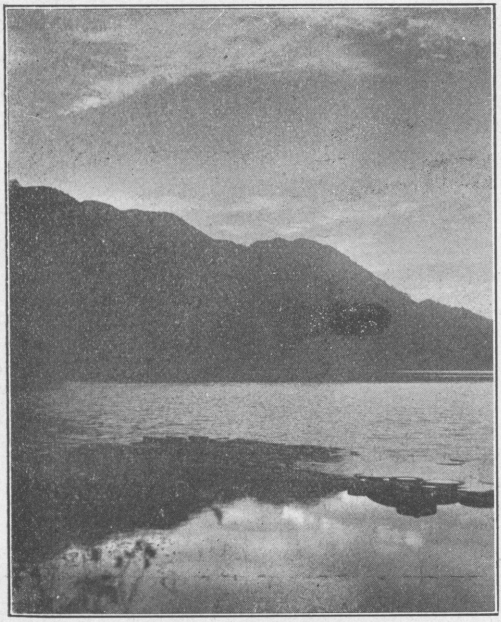


Fig. 38. View of Lake Kawaguchi, showing the surrounding vegetation. Phot. B. HAYATA, Oct. 24, 1925.

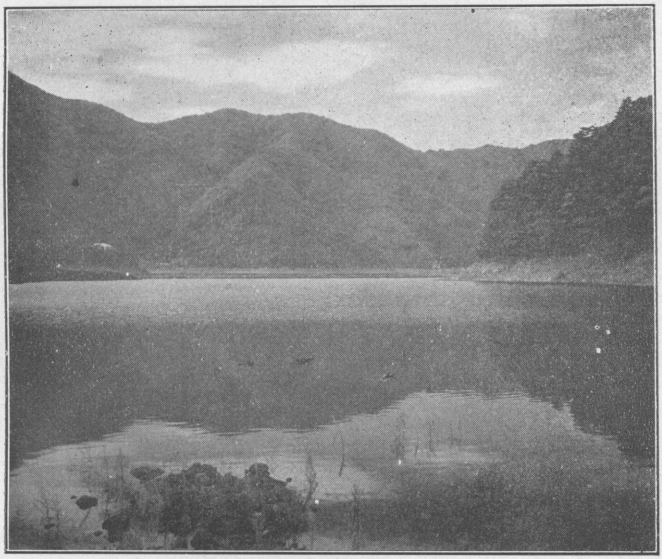


Fig. 39. View of Lake Shōji, seen from the eastern side of the lake: the white spot in the forest on the opposite bank is a hotel. Phot. B. HAYATA. Oct. 24, 1925.

Fig. 40. View of Mt. Fuji, seen from the top of Mt. Ubōshigatakė, the Omuroyama monticule is seen at the left center of the picture. Phot. B. HAYATA, No. 19, 1924.

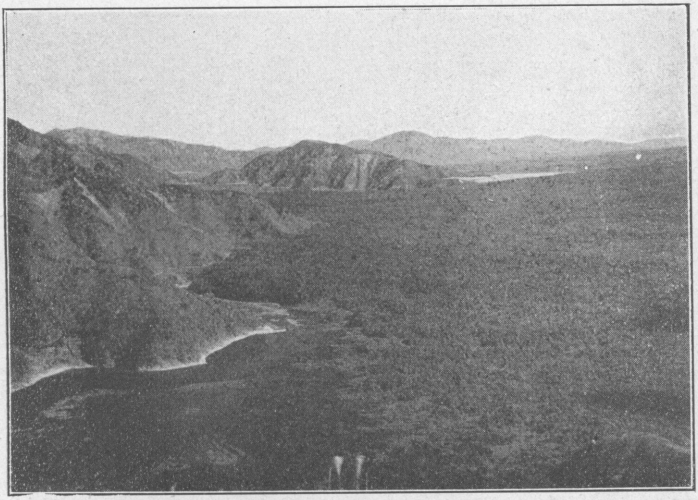


Fig. 41. Fiew of the western foot of Mt. Fuji, looking east from the top of Mt. Ubōshigatakė. On the right of the picture, across the grand forest of Aogigahara, there is seen a *Miscanthus*-formation on the loamy hill near the beginning of the forest; of the lakes in the picture, Lake Kawaguchi s the forthest, then a little nearer to us is Lake Saiko, and finally, in the left foreground Lake Shōji. Phot. B. HAYATA, Nov. 1924.

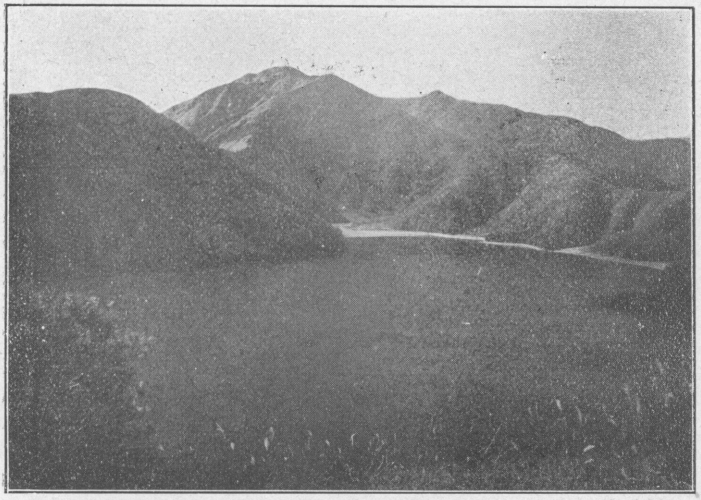


Fig. 42. View of Lake Motosu, looking to the west from the top of Mt. Ubōshigataké. Phot. B. HAYATA, Nov. 1924.

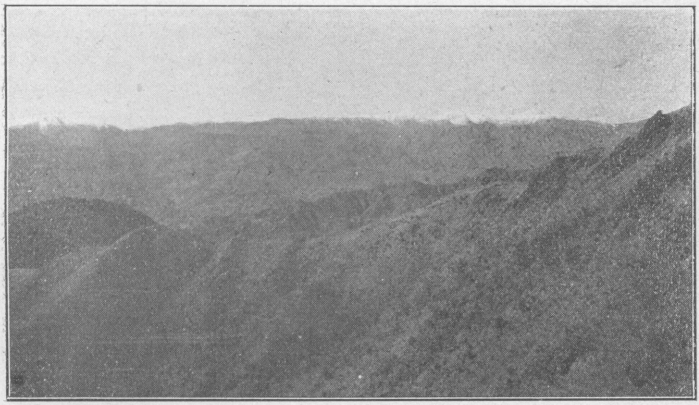


Fig. 43. View of the distant mountains of the Shiraminé and Akaishi ranges, looking to the west from the top of Mt. Ubōshigataké. To point them out from left to right, the snow clad prominence at the extreme left is Akuzawagataké (3146 m.), then comes Kōmorigataké (2865 m.), then Shiomigataké (3047 m.), all belonging to the Akaishi range; then follow the peaks of the Shiraminé range, the first on the left being Mt. Hirokōchi (2718 m.), then Mt. Toyoshima (3026 m.), then Mt. Manogataké (3189 m.) and finally Mt. Kitagataké (3192 m.).* Phot. B. HAYATA, Nov. 1924.

* I am greatly indebted to Dr. S. OGURA for his kindness in giving me all the names of the mountains in this photograph

5) From Gotenniwa to Shōji

We now proceed by the highroad to Lake Shōji. It is already evening when he find ourselves by the lake (fig. 39). Here we see on our left dark green conifers growing on the lava of Aokigahara, and on our right a Tertiary hill clad with pines drooping down to the lake. The water is wonderfully clear. At this time of the evening, it mirrors opalescent tints, reflections of the sun just setting behind the mountains on the opposite side of the lake. Yonder, sheltered in the forest, stands a white cottage by the water's edge. It is the hotel where we have to stop for a night. To it a boat will take us across the lake.

If time permits, it is better to climb Mt. Ubōshigatakė (1,257 m.), which rises on the western side of the lake, to gain a view of Mt. Fuji; for it is only towards the close of the day when the mountain is illuminated by the setting sun that we can observe the vegetation on this side from a distance (fig. 40). From this hilltop we command a most magnificent view of the snow capped truncated cone, outlined sharply against the pure blue autumnal sky, and spreading its skirt of dark green conifers far and wide. Due east, and far away across the grand forest of Aokigahara, we see Lake Kawaguchi; a little nearer to us, is Lake Saiko and under our feet on the left side, Lake Shōji (fig. 41). On the west, surrounded by the mountains is Lake Motosu (fig. 42). To the southeast, an extensive view of the grand forest of Aokigahara opens before our eyes. Here we see the most extensive of the lava-streams, extending from above the upper monticules down to the margin of the lakes. It measures nearly a kilometer in its middle breadth, and sends out branches on both sides, leaving several monticules and loamy areas uncovered. Roughly speaking, we find dark green conifers on the lava, deciduous broad-leaved trees on the parasitic cones and *Miscanthus* formation on the loamy areas. Here, we see in the immense forest of evergreen conifers several limited plots occupied by deciduous trees or grasses, and we fancy that we are looking at coppice islands in an expanse of dark blue sylvan water. Far to the west, we command a panoramic view of the distant snow clad mountains of the Shiraminé and Akaishi ranges (fig. 43).

6) From Shōji to Kamiide

Second day. In the morning, we bid farewell to the lovely lake and proceed southwards. Presently we come to the very edge of

Aokigaharamarubi and see the immense dark green forest stretching away before us. On the left side are evergreen conifers, but on the right deciduous broad-leaved trees. The latter consist of several kinds of *Acer*, *Carpinus*, *Fagus*, *Quercus*, *Viburnum* and others, with a luxuriant undergrowth of a dwarf bamboo, *Sasa borealis*, and *Carex Morrowii*. Of the ferns, two kinds of maiden hair (*Adiantum monochlamys* and *A. pedatum*) are the most lovely. Also, *Dryopteris Sabeii*, *D. polylepis*, *Polystichum varium*, *P. tripteron* are worthy of notice. Of the maples, *Acer japonicum* predominates.

Now we come to Lake Motosu nearly six miles distant from Shōji. At Motosu, we take leave of the grand forest of Aokigaharamarubi, and go on due south along the hill keeping the lovely lake in view on our right. Far away on the opposite side, we see the distant snow capped peaks of the Shiraminé-range, superposed on the mountains surrounding the lake (fig. 44).

Thus, we come to a broad grassy region, covered with *Miscanthus sinensis*. Above us the truncated cone towers up on our left. On the northern side of its flank, at the very base, we see the three monticules which we had seen the day before from the opposite side. The largest and nearest one is Ōmuroyama, next towards south and a little further away is Nagaoyama, and the other a little nearer to us is Katabutayama. All three are clad with a dense forest on their northern sides, but are quite denuded on the south. This curious, one sided preservation of a forest is principally due, not directly but indirectly, to the direction of the slopes, winds and sunshine. We can easily imagine that, in former times in these regions, there must very frequently have taken place wild fires which resulted the complete annihilation of forests. The forests on the southern side of the monticules, being generally exposed to severe desiccation by the strong local wind and by the direct sunshine, when once destroyed, would not be replaced; for they would be visited by fires again and again and be utterly destroyed, before they could attain a stage of restoration sufficiently advanced to enable them to resist the small forest fires which frequently occur. The northern sides of the cones are, on the contrary, as the direction of the slopes should make clear, protected from the desiccation caused by the sunshine and the local wind, mostly southwestern in the dry season. Consequently the ground here keeps wet throughout the year, and moreover the snow remains till late in the spring. These conditions are undoubtedly

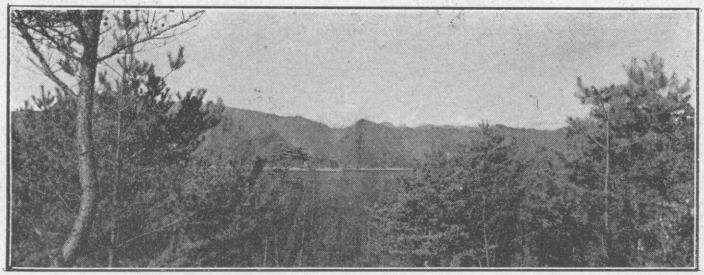


Fig. 44. View of the distant mountains of the Shiraminé-range, seen from the eastern bank of Lake Motosu. The snow clad peaks of Mt. Toyoshima (3026), Mt. Manogataké (3189 m.) and Mt. Kitagataké (3192 m.), in order from left to right, at one time are hidden from view by the slow drifting clouds, but make their appearance at another. Phot. B. HAYATA, Nov. 1924.

Fig. 45. View of Mt. Fuji seen from Ōkawara. Phot. B. HAYATA, Oct. 25. 1925.

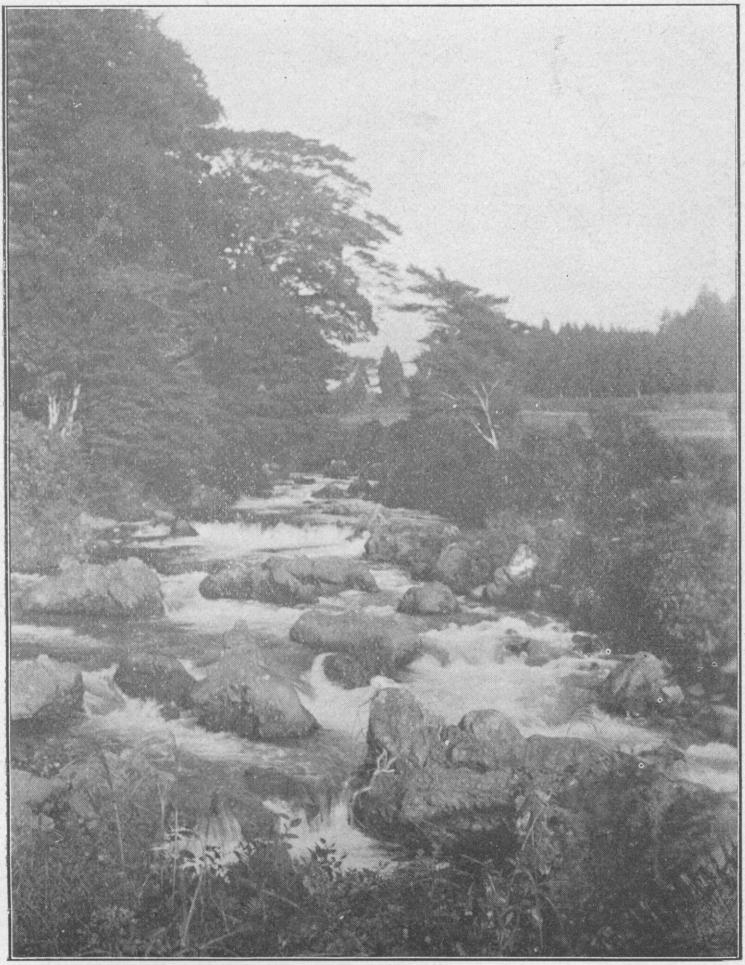


Fig. 46. Rapids of the Shibakawa, the home of *Prasiola japonica*. Phot. B. HAYATA, Oct. 27, 1925.

Fig. 47. View of Mt. Fuji, seen from Kitayama; several growths of *Alnus* along valleys look like streams flowing down from the forest-region into the grassy plain. In the left foreground a mulberry plantation. Phot. B. HAYATA, Jan. 1925.

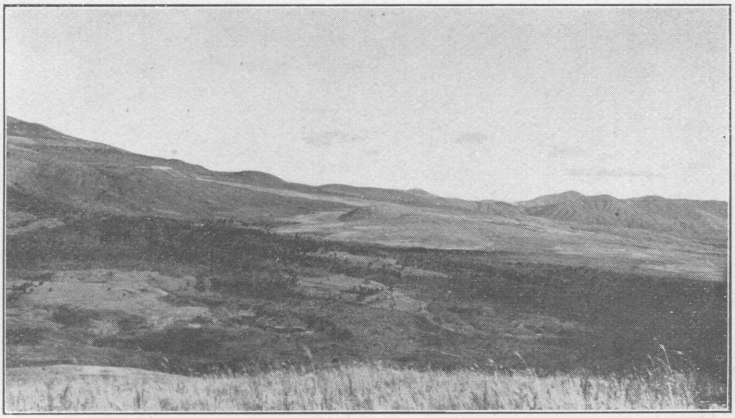


Fig. 49. View of the south-eastern foot of Mt. Fuji, seen from Mt. Ashitaka. Explanation in the text. Phot. B. HAYATA, Nov. 18, 1924.

favourable to restoring the forests and preventing fires. Meanwhile we come across a deciduous growth descending from the upper tree region far down to the grassy plain. This is a thicket, growing on the furcate end of a branch of the Aokigahara lava-stream.

We cross Wariishi Pass and reach the village of Nebara, 4 km. from Motosu, and 12 km. from Shōji. Here we see an old fashoned village, the houses of which are ornament with flattened crosses laid upon the roof-ridges. Passing Nebara, we come to the grassy plain called Sanrigahara, where we find several dwarf bamboo formations studding a wide field of *Miscanthus*, which thus presents a strange mixture of green and yellow.

As we proceed straight southwards, and the sun also goes to the south, the differentiation in the forest regions becomes more and more striking. We notice that evergreen conifers predominate towards the northern flank, while deciduous broad-leaved formations are most luxuriant towards the southern. Above the dark blue conifers the *Larix* region is clearly distinguishable by its peculiar autumn tints. Presently we cross another stream of lava on which, as is usually the case, is found a thicket, composed mainly of *Quercus serrata* and *Ilex crenata* with shinning dark green leaves and black ebony drupes. Hidden in this thicket is another village, called Hitoana, 24 km. distant from Shōji.

A little further on we pass a dry river bed called Ōkawara (fig. 45). From here the view of the truncated cone shows, at the center, a large fosse, called Ōsawa, the lower course of which we have just passed. On both sides of the fosse, especially on the south, above the evergreen conifers, we see most vividly the *Larix*-formation, which here attains its widest extension.

7) From Kamiide to Gotemba

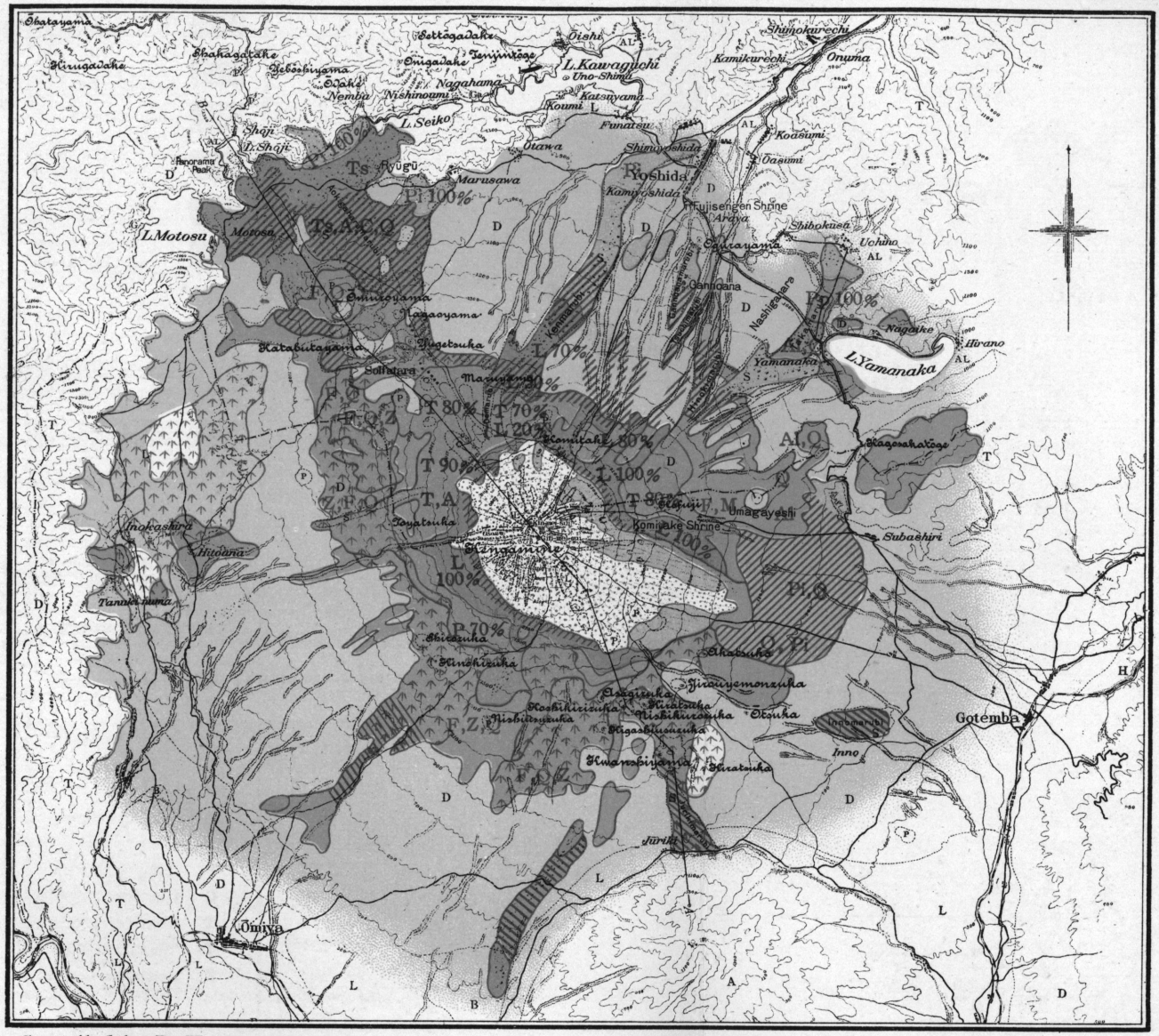
Presently, we pass through numerous *Cryptomeria*-forests, and following down along a rapid in which is an interesting green alga, *Prasiola japonica* (fig. 46). We reach the village of Kamiidé and soon are at Kitayama. Now look again at the volcano (fig. 47). The truncated top on this side has a triangular point in the middle. This small peak is called Kengaminé, and is the highest of the several peaks around the crater. Presently we reach Ōmiya, a small town of some commercial importance. From Ōmiya we take the train. It is already dusk. From our window on the left side of the car, we see the cone faintly outlined with its thin filmly snow cap, tinted a

delicate rose by the sinking sun. To the east, can be seen a mountain-range ascending from south to north up to the foot of the volcano. This is Mt. Ashitaka, an extinct volcano, much older than Mt. Fuji. Far up on the grassy slopes of the latter, we see many sylvan bands descending radially to the very foot. They are growths of alders which thrive along the valleys. Our train goes straight to the Pacific coast. At Fuji station, we change to another train coming from the west. It takes us eastward around the Ashitaka-range. For a while we lose sight of Mt. Fuji and pass Numazu, Mishima and Susono. Then again we come in the view of the volcano. The train now climbs the slope and at last we reach Gotemba. Thus, we complete the circuit of the noble mountain. We bid farewell to the volcano and return eastwards by the same way by which we had gone on the previous morning. Our time has been rather too short for a full observation of so interesting a mountain; but the pleasant impression which this trip has left upon our memory will be long remembered.

There is another route from Kitayama, nearly midway between Kamiidé and Ōmiya, which leads straight eastwards to Gotemba. The route leads us to the saddle between Mt. Fuji and the Ashitaka-range, whence we climb the northern end of the range. From there we see the truncated cone (fig. 48) on the north, and obtain a most magnificent view of the southeastern flank of the mountain, which, except on the upper bare region, is thickly clad with forests on its western half, and thinly on its eastern half. This is certainly due to the ejectamenta from the parasitic cone, Hoyé. A little east of the middle, at the bottom of an enormous depression walled with a nearly perpendicular cliff which is partly broken down on this side, stands the rounded cone of Hoyé, which when active threw its ejectamenta over the basal region as far as to the Hakoné mountains. Below the monticule and eastwards from it we see a pair of much smaller cones, called Futatsuzuka equally bare of any vegetation. Far down on the eastern flank we have another rounded cone, the Akatsuka, clad with a deciduous forest. The next one, on its western side, is Jiroyemonzuka which is densely clad with dwarf bamboo thickets on its sides, but with grasses on its top. Next towards the west and a little lower, is a group of three or four monticules, the outer ones on each side having well-marked craters. They are clad with bamboos or deciduous broad leaved trees, and with some evergreen conifers. A little higher up again towards the west, next to Kansuyama, we have three monticules. To name them from right to left, the first is Katabokko, next comes Mizugatsuka, and the last is Koshikirizuka. The first is clad with deciduous broad-leaved trees on the further side, but with dwarf bamboos on this side, while the other two are entirely clad with dwarf bamboos. On the west, a little apart from these ones, at nearly the same altitude, we see another cone, called Higashiusuzuka, partly clad with forest and partly with dwarf bamboos and grass. Now turning our attention to the east, far down on the grassy plain we see a very regular rounded cone with a regular crater. This is called Hiratsuka and is exclusively clad with a most luxuriant formation consisting solely of one kind of a dwarf bamboo, *Sasa hiratsukensis* (fig. 49).

Let us now take a general survey of the vegetation on this side of Mt. Fuji. As is usually the case, the uppermost aboreous formation consists of *Larix*, then next below come the evergreen conifers, and lowest, the deciduous broad-leaved trees. Turning our attention to the lower grassy region, we find that in its western half it ascends far up to the foot of Jiroyemonzuka. On the western flank, the grassy plain is, on the one hand, intersected by a chain of forests thriving on the Nakabosamarubi lava stream, and by a number of afforested plantations of *Cryptomeria* or *Chamaecyparis*. On the eastern flank we see, on the other hand, an immense plain called Ōhnohara with many nearly continuous *Miscanthus*-formations extending for miles as far as Gotemba. On the saddle between

BOTANICAL MAP OF MT. FUJI



Forest of Pinus densiflora

Pinus forest with deciduous broad-leaved trees

Grass region

Grass region with deciduous broad-leaved trees

Forest of deciduous broad-leaved trees

Broad-leaved forest with evergreen conifers.

Forest of evergreen conifers

Evergreen conifers with deciduous broad-leaved trees

Larix region

Larix region with deciduous broad-leaved trees

Alpine stretches

Baren region

Dwarf bamboo formation

A	Abies homolepis
Al	Alnus incana
C	Chamaecyparis obtusa
F	Fagus
L	Larix leptolepis
M	Maackia
O	Ostrya
P	Picea jezoënsis
Pp	Picea polita
Pi	Pinus densiflora
Q	Quercus
T	Tsuga diversifolia
Ts	Tsuga Sieboldi
Z	Zelkowa

Compiled by B. HAYATA

Scale 1 : 200,000

1926

Fig. 1. An early stage of sunrise, seen from an altitude of 3,340 m. near the top of Mt. Fuji; a small red spot in a dark sea of clouds.

Fig. 2. A somewhat later stage ; a semicircular disc of crimson.

Fig. 3. A still later stage; a burning ball rising above the dark surface of the fleecy clouds, as yet partially hidden.—Figs. 1-3, photographed by B. Hayata, Aug. 16, 1926.

Mt. Fuji and Ashitaka, there exists an extensive area with numerous patches of deciduous broad-leaved trees and evergreen conifers. This is certainly due to the Jūrigimarubi lava-stream. Looking far up at the forest regions again, we notice a dark streak connecting Higashiusuzuka and Koshikirizuka in the deciduous forest. It is a coniferous formation, greatly shortened in its breadth by the perspective, for it stands on the Minamihinoki lava-stream. The formation consists of a pure stand of *Chamaecyparis obtusa*.

Crossing Jūrigi Pass, we come to Ōhnohara. Thence descending north-eastwards we reach Inno, where we find a deciduous forest, extending over an area measuring nearly 120 hectares and growing on the Inno-marubi lava-stream. Passing Takigahara, and keeping on down straight eastwards, we arrive at Gotemba, thus completing our circuit of the noble mountain.

CONTENTS

GEOLOGICAL GUIDE TO THE LAKE DISTRICT AROUND MT. FUJI

By Takeo Katō and Keinosuke Ihara

I. THE VOLCANO FUJI AND ITS ENVIRONS

General Remarks

Mt. Fuji, the highest mountain of Japan proper, is known the world over for its flawless beauty. Its perfect cone rises to a height of 3,778 meters above sea-level. In July and August swarms of pilgrims and alpinists climb its sacred slopes to the summit, which commands a magnificent view, the sunrise aspect being markedly impressive. There are six trails to the top, the Gotemba (Tōkaidō Main Line) and the Yoshida, reached via Ōtsuki (Chūō Line), being the most popular. Mt. Fuji is bounded on the west by the Kenashi Range, and on the north by the Misaka and Dōshi Ranges, all composed of Tertiary formations. On the east, its skirt comes in contact with the Hakone volcano, forming an intermontane valley, in which the town of Gotemba is located. On the south, its slope is interrupted by a dissected volcanic cone by the name of Ashitaka-yama whose slope descends gradually to the Bay of Suruga.

Mt. Fuji is characterized by a long, gentle slope with similar inclinations on all sides except the southern, where the explosion crater of Hōei-san breaks the monotony of the curve. Near the summit, the inclination is as steep as 34° and no trace of vegetation

is found, but in the middle portion, which is densely forested, the inclination is only 17°; as descent is made, the slope becomes more and more gentle, forming an extensive skirt overgrown with *Miscanthus*. At the summit, the main crater is found. It is a funnel-shaped depression, about 220 meters in depth, about 600 meters in the upper diameter and only 70 meters in diameter at the bottom.

The Fuji lake district lies along the northern skirt, where intermontane basins have been formed between the volcano and the pre-existing mountain ranges of the Tertiary formation. Five lakes are found there, namely, Motosu, Shōji, Seiko, Kawaguchi and Yamanaka, as enumerated from west to east.

Geological Sketch

Mt. Fuji is a typical strato-volcano in a young topographical stage, and is characterized by numerous radial gullies. It is built up of lava flows irregularly alternating with layers of fragmental materials such as lapilli, scoriae, ashes, etc., piled on the core or basement mass, which consists also of fragmental ejecta. Several lava flows are observed in the Ōsawa, the largest radial gulch on the western flank. Some of the lava flows seem to have been ejected from the crater in vast quantities and to have spread down to the foot of the volcano in all directions. For example, the lava of the Mishima-Ōmiya type is exposed extensively around the skirt, though on the flank it is deeply concealed beneath fragmental ejecta and later lava flows. Another example is the lava of the Enkyō type which is largely buried under fragmental ejecta, but is exposed at many places on the flank, especially on the northern side where the lava, on reaching the foot, has narrowed in width and flowed down along the river course of the Katsura-gawa as far as the vicinity of Enkyō, about 30 kilometers from the crater.

It is highly probable that the volcanic core is traversed by numerous radial dykes, as revealed in the wall of the explosion-crater of Hōei and as indicated by the presence of numerous parasitic cones arranged in radial and concentric ways on the slopes.

Lava streams of comparatively recent date are found here and there on the slope surface. The Aokigahara lava stream which poured out of the main crater[1] and flowed down toward the north in 864 A.D., is one of the most conspicuous. It extends to the northwestern

1) It is believed by some that this lava poured out of a side crater formed on the northwestern flank.

foot and separates Lake Motosu from Seiko, covering an area of about 32 sq. kilometers, which is densely forested. A long, narrow lava stream probably of the some date, called "Ken-marubi" is found on the northeastern slope ; it terminates in the vicinity of the town of Yoshida.

The surface of most of the lava streams is vescicular and slaggy in structure, though sometimes ropy lavas are met with. Lava tunnels, caverns and sacks are of common occurrence in the lava streams around the mountain skirt. More than 20 lava tunnels, commonly characterized by lava stalactites, are found. They are several meters to several hundred meters in length along the direction of the flow of the lavas, and flat-elliptical or circular in cross-section. Among others, the lava tunnels called " Gan-no-ana " and " Tainai " are found near the town of Yoshida in the " Ken-marubi " lava stream. Impressions of trees are abundantly found in the lava flows of recent date, e.g., in the Aokigahara lava stream. They were formed by the molten lava which flowed over forested regions, charring and burning the tree trunks, moulds of which remain as vertical hollows.

Of the lavas composing Mt. Fuji, the lowermost one, called the Ōsawa lava, is an olivine-bearing pyroxene-andesite or basaltic andesite, while all the others belong to the plagioclase basalt. They are all characterized by the presence of abundant yellowish green augite and a little hypersthene. The following is the result of an analysis of a typical Fuji lava :—

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5	Total
47.77	20.59	6.06	5.11	0.20	10.37	5.00	0.84	1.08	0.73	0.16	99.89

Under the microscope, the typical lava shows a porphyritic texture, phenocrysts of plagioclase (anorthite), olivine and common augite being embedded in a groundmass consisting of lath-shaped feldspar, augite prisms and magnetite grains in admixture with more or less glass as a basis. Hypersthene is sporadically present. Occasionally, glassy lavas consisting almost wholly of brown glass with small amounts of microlites of feldspar, augite and olivine are met with.

Numerous parasitic cones, more than 40 in number, are found on the slopes of Mt. Fuji. They are either lava or cinder cones and are of rather small dimensions, the largest, which is called Ōmuro-yama and is situated on the northwestern skirt, being about 375 meters in height. Most of the parasitic cones have a small crater on the top, while a few of them have given rise to lava streams as in the case of Kansu-yama on the southern slope. The cones are generally arranged in radial and concentric lines, having the main crater as the center, but the most crowded are the radial zones in the NNW-SSE. direction.

The lavas composing the parasitic cones have the same petrological character as those of the main volcano. It is evident that the cones were erupted along radial and concentric fissures formed in the mountain body around the main volcanic channel.

Ashitaka Volcano

Mt. Ashitaka is a dissected volcano with a height of 1,504 meters above sea-level, standing on the southern slope of Mt. Fuji. It is also a strato-volcano consisting of lava flows and layers of fragmental materials. The lavas are similar in character to those of Fuji, belonging to the basaltic andesite type, with abundant olivine, augite, hypersthene and basic plagioclase as phenocrysts. A ruined crater is found at the summit in which numerous dykes are exposed ; and a large explosion crater, called Ōsawa, exists on the northeastern slope.

The activity of this volcano probably began at the same time as Mt. Fuji, but it became extinct before the latter. Consequently the volcano has undergone conspicuous erosion causing the formation of the present ruined cone. Its northern skirt has been buried under the ejecta from Fuji.

The Foundation of Mt. Fuji

The foundation of Mt. Fuji consists of the so-called "Misaka Series," which forms a mountainous district covering an enormous area in this part of Japan. The series is composed of beds of various pyroclastic and sedimentary rocks, such as diabase-tuff, tuff-breccia, sheets of diabase porphyrite, shale, sandstone, limestone, and other kinds of rock, into which have intruded diorites, diabases and other basic and intermediate igneous rocks in the form of stocks, laccoliths and dykes. The limestone exposed on the northwestern bank of Lake Kawaguchi contains abundant fossils such as *Orbitoides*, *Lithothamnium*, etc. The complex of sandstone and shale which is exposed along

the Katsura-gawa is also in some places rich in fossils, such as *Astriclypeus integris* Yosh., *Pecten laetus*, *Pectunculus* sp., *Carcharias* sp., bones and teeth of *Physeterinae*, teeth of *Myliobatis cornuata*, Gthr., *Lithothamnium* sp., and others, and seems to be conformable with that containing *Orbitoides* limestone and tuffaceous beds. This series has a general trend of NE, often with steep inclinations.

The Tertiary formation of this district[1] is thus of Miocene age, and together with the intrusive rocks may be regarded as a forerunner of the volcanic activity of the Fuji volcanic zone, which occurred along the great meridional tectonic zone called the Fossa Magna and has continued up to the present time, the climax having been reached in the Pleistocene epoch.

Before the appearance of Mt. Fuji, the Misaka Series, which is largely of submarine deposition, had been upheaved and folded giving rise to mountains of 1,700 meters or more above sea-level, and eroded and dissected to a mature topography.

The Evolution of Mt. Fuji

The evolution of Mt. Fuji began probably during the early Pleistocene epoch following the great crustal movement of the post-Miocene age and the formation of the mountain ridges due to erosion through the Pliocene epoch. The first activity of Mt. Fuji is represented by the accumulations of the fragmental ejecta of the besement, and successive eruptions by the repeated lava flows and ejecta layers, which have given rise to the beautiful conical form.

In historic times, several eruptions and explosions have been recorded, of which the following three are most noteworthy :

1. On April 15th, 800 A.D. (19th year of the Enriaku era), a violent eruption took place. A lava stream flowed down along the Katsura-gawa and reached the Enkyō bridge.[2] (?)
2. In August, 864 A.D. (6th year of the Jyogan era), a great eruption occurred. On this occasion, two great lava streams flowed down along the northern slope. One is the Aokigahara lava which rushed into the intermontane lake at the northern foot and separated it into two lakes; namely, Motosu and Seiko ;

1) A younger Tertiary formation, probably of Pliocene age, is developed in the vicinity of Ôtsuki along the valley of Katsura-gawa. It is composed chiefly of conglomerates and sandstones, sporadically with a lignitic coal seam, and is underlain uncomformably by the Miocene complex.

2) It is highly doubtful that the Enkyō lava is of historic date. It is evidently planated by alluviation, being in some places covered by a gravel bed, and is deeply cut by the Katsura gawa.

the other is the slaggy lava of Ken-marubi, which forms a tongue-shaped flow elongated to the northeast and terminating in the northern vicinity of the town of Yoshida.

3. On December 16th, 1707 (4th year of the Hōei era), a great explosion took place on the southeastern flank. A large explosion crater was formed, viz., the Hōei-san crater, by which the beautiful conical form of the mountain was slightly altered. At this time, no conspicuous lava was effused, though a great quantity of bombs was ejected. This is the last great activity of Fuji Volcano, though small explosions have since been recorded in 1708, 1792, etc.

At the present time, the volcano is in a dormant state. Traces of fumaroles exist on the east side of Idzu-dake and at Yasugawara on the top, where steam was feebly issuing until a few years ago. The existence of fumaroles in the past at many places around the main crater is recorded, but they are now invisible except for traces caused by rock-decomposition.

The Five Lakes

The Fuji lake district, as already stated, lies along the northern foot of Mt. Fuji, where the skirt of the volcano is in contact with the mountain ranges composed of the Misaka Tertiary formation, forming intermontane basins.

Of the five lakes found there, namely, Motosu, Shōji, Seiko, Kawaguchi and Yamanaka, the first three form one characteristic group. Their area and maximum depth are as follows :—

	Area	Maximum depth
Motosu	5.05 sq. km.	132 m.
Shoji	0.75 sq. km.	25.5 m.
Seiko	2.14 sq. km.	90.9 m.

These three lakes have no outlet, and their surface level is of almost the same height, i.e. about 908 meters above sea-level. It is believed by some that their waters are connected through the porous lava and debris and that the water thus percolating into the ground supplies the source of the river Shiba-kawa, which flows southward to the Bay of Suruga. The three lakes formed formerly a great lake, called Seno-umi, which was divided into three by the lava flow at the time of the great eruption of 864 A.D.

Of the remaining two, Kawaguchi lake, the water level of which is 830 meters above sea-level and which is separated from Seiko by a pass called Torii-tōge, 960 meters above the sea, covers an area of 5.79 sq. km. and is 21.8 m. in maximum depth. The other, Yamanaka lake, whose water level is 982 meters above the sea, (this lake is thus the highest of the five in position), covers an area of 6.67 sq. km. and is 16.4 m. in maximum depth. The former is connected with the Katsura-gawa by an artificial channel, and the latter has an outlet which forms the source of the Katsura-gawa.

II. ITINERARY

Route from Tokyo to Yoshida

This route covers a distance of 52.2 miles on the Central Line from Iidamachi Station in Tokyo to Ōtsuki Station, and 15 miles from Ōtsuki to Yoshida by the Fuji Electric Railway or by motor car. The Central Line traverses a country noted for its diversified topography. The eastern part of the route lies on a broad, well-cultivated plain called the Kwantō, which rises gradually to the west, until it becomes hilly and even mountainous at last. Starting from Iidamachi Station, the train proceeds straight west as far as Tachikawa, through the high land of the Tokyo district, which is composed of loam underlaid by clays, sands and gravels. Passing Tachikawa Station and crossing the Tama-gawa, the train arrives at the city of Hachiōji, which is noted for its silk industry.

As the train approaches the western limits of the extensive Kwantō plain, the mountains come into sight. The most conspicuous are those bordering the Kobotoke pass (521 m.) which forms on entrance to the Prefecture of Yamanashi. The hill to the southeast of the Kobotoke pass is called Takao-san and is well known for its scarlet maples in the autumn. After passing Asakawa Station, the train follows the rocky valley of the Kobotoke River and passing through the Kobotoke Range by tunnel, comes to Yose Station, located on a terrace of the Katsura-gawa. All these mountainous districts comprise the so-called "Kobotoke System" (Palaeozoic) which is chiefly composed of clayslate, graywacke sandstone, quartzite and conglomerate, and rarely limestone and schalstein. No fossils have been found in the system except a few indeterminable plant remains. The strata are highly inclined with a general strike NW-SE.

For a distance of 25 km. westwards from Yose, on the latter part of the route, the railway is laid along a valley between two mountain ranges, the Kobotoke and the Dōshi. In this valley, high bench-like terraces are well preserved on both sides of the river. The terraces are remarkable especially in the vicinity of Yose and Uyenohara, and are ovarlaid by gravel or loamy earth, the basement rock being mainly Tertiary conglomerate, which was deposited in an old valley of the Palaeozoic terrain. Near Yenkyō Station the train crosses a gorge of the Katsura-gawa immediately after passing through a tunnel, and a good view of the beautiful waterfall, Omoi-ide-no-taki, and of a fantastic hanging bridge called Saru-hashi ("monkey bridge") may be obtained. The bridge, about 30 m. above the water, connects perpendicular bluffs which consist of lava known as "Yenkyō lava" resting on a basement of Tertiary tuffaceous conglomerate. It is one of the most noted bridges in Japan. The "Yenkyō lava" with its source in the northern side of Mt. Fuji, flowed down the valley of the Katsura-gawa as far as the town of Yenkyō, and is well exposed on the cliffs and in the bed of the river, especially between the Saru-hashi and the Tawara-daki (waterfall) near the town of Yamura. The lava is generally 5 or 6 m. thick and shows a columnar structure, as seen at Yenkyō, Ōtsuki and Tawara-daki.

We now arrive at Ōtsuki Station and get off the train. On leaving the town of Ōtsuki by electric or by motors excursionist will catch their first glimpse of Mt. Fuji, and will also see the "Yenkyō lava" exposed in the valley. The mountains on both sides of the valley are composed of conglomerate, sandstone and shale of the younger Tertiary period, and the higher mountain tracts beyond consist of the so-called Misaka Series of the older Tertiary age. Sericulture is the principal industry in the valley district; and we may observe the mulberry farms as well as the reels and looms which are kept in every house.

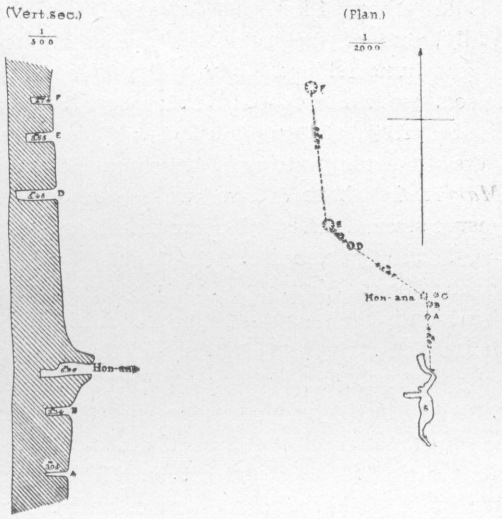
After passing the small villages of Tanokura and Yokkaichiba, the car reaches Yamura, a town noted at the location of the Kaiki-Silk market. Near Tōka-ichiba, where the car crosses the gorge of the Katsura-gawa, a beautiful waterfall and lava flow may be sighted below the track. The fall, known by the name of Tawara-daki, has a height of about 25 m. and flows over the "Yenkyō lava." From here down the valley, a deep gorge extends and the lava is exposed

on both cliffs, showing a beautiful columnar structure. Interesting pot-holes in the lava, especially at the head of the waterfall, are noticeable from the car.

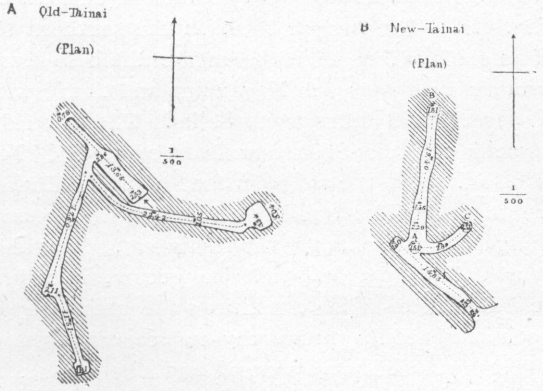
Going up a gentle slope southward through Onuma, visitors will find themselves standing among numerous blocks of slaggy lava, which present an entirely different aspect from those of the districts hitherto traversed. This place is the terminus of the lava stream called *Ken-Marubi*. In front the majestic cone of Mt. Fuji and a small but conspicuous ridge callled Ogura-yama may be sighted from the car. The latter consists of sedimentary rocks of the Misaka Series, mainly composed of tuffaceous conglomerate. The prominent mountain which rises steeply to the northwest of Onuma is Mitsutōge, the highest in the Misaka range. Now we reach the town of Yoshida, which is situated on the northeastern foot of Mt. Fuji. At its southern end will be found the Shintō shrine of Sengen-Jinsha, standing in the midst of a beautiful wood. This is the shrine of the guardian goddess of Mt. Fuji, small images of whom are frequently met with along the routes of ascent.

There are two groups of peculiar lava tunnels called *Gan-no-ana* and *Tainai*, situated respectively about 3.5 km. south and about 4.5 km. southwest of Yoshida. *Gan-no-ana* consists of a massive cone, lava tunnels, lava sacks and vertical holes in the *Gan-no-ana Marubi* (lava stream). Here a massive miniature cone 3 m. high is most noteworthy on account of its conspicuous form. It is called *Kombo-yama* and is made of slaggy lava having a crater-like vertical hole, *Hon-ana*, on its top. At the foot of the cone are three well-like holes which are entirely unconnected. At a distance of about 44 m. south of the cone, there is observed a large lava tunnel, which is partly depressed, forming so-called lava sacks. Other vertical holes are found to the north of the cone. *Tainai* is on the lava stream called *Ken-marubi*, about 1 km. wide, and is divided into two groups, known as the old and new *Tainai*, which are found respectively on the east and west edges of the stream. The mouth of the old *Tainai*, which faces the southeast, has a height of 1.5 m. and a width of 2.5 m. After running for a distance of about 10 meters toward the nortwest with a gentle slope, the tunnel branches off into two, the *Chichino-tainai* ("Father's *tainai*") to the south and the *Hahano-tainai* ("Mother's *tainai*") to the east. The New *Tainai* consists of three tunnels and three vertical holes. It is more complex in structure

Gan-no-ana



Tainai



than the "Old *Tainai*". The mouth of the lava tunnel, 1 m. high and 1.7 m. wide, opens to the southwest, and, running straight to the northwestward, passes into a vertical hole about 6 m. deep; from the bottom of the hole two tunnels run off, one to the northeast and the other to the north.

From Yoshida to Shōji

At a point about 1 km. northwest of Yoshida, the highway crosses a gully, one of the numerous gullies known an *Happyaku-yasawa* (" Eight hundred and eight valleys "), and then, passing an uneven surface, we come to a black slaggy lava stream which is slightly elevated from the ground level. This is one of the most remarkable lava-streams pouring down from Mt. Fuji, and is called *Ken-Marubi*. It is about 500 m. wide and exhibits a peculiar topography over several miles. It is quarried for the purpose of road-making as well as for garden use.

Going on about 3 km. to the northwest, we reach Lake Kawaguchi, which is the largest of the five lakes and is noted for its reflection of Mt. Fuji. It lies 830 m. above the sea-level, the circumference being about 20 km. and the depth 19 m. With the sublime cone of Mt. Fuji reflected on its surface and with beautifully wooded skirts to the south and the steep slope of Koro-dake to the north, the lake presents a delightful scene to visitors. Uno-shima, a small island in the centre of the lake, is composed of tuffaceous conglomerate belonging to the Misaka Series. The limestone at the Tenjin pass on the northern shore of the lake contains many fossils such as *Lepidocyclina*, calcareous *Algae*, *Nummulites*, spines of crinoid, *Carpentalia*, *Amphistegina*, etc. The rugged bank on the southern shore is the terminus of an old lava flow which belongs to the base lava. Crossing the lake by motor boat we reach Nagahama and then a walk of about 15 minutes over the hill takes us to Seiko. The low ridge between Lake Kawaguchi and Lake Seiko is called Torii-tōge (" Torii pass "), which rises 139 m. above the water surface of Lake Kawaguchi, and 51 m. above that of Lake Seiko. It is a bridge connecting two mountain ranges, the Misaka and the Ashiwada. Near the top of the Torii-tōge, a dyke of quartz-andesite occurs, intruded into the tuffaceous conglomerate which constitutes the main body of the hill. The dyke rock is especially noteworthy on account of the presence of garnet crystals as an accessory mineral and also on account of the well defined contact phenomena in the adjoining rocks.

After crossing Lake Seiko by motor boat, we reach Nemba. The lake lies at an altitude of 905 m. above the sea-level with a circumference of 12 km. and a depth of 766 m. To the north, the Misaka range with a steep slope presents a glorious view of the Jūni-ga-dake, (" Twelve rugged peaks ") of which the loftiest attains a height of

1,750 m. To the south, the lake is bounded by the steep slope of the Ashiwada range, and to the west, lies a tableland, called Aoki-ga-hara which consists of a great lava flow. A lava tunnel, known as *Kōmori-ana*, is found on the western shore of the lake. It is really a group composed of the tunnel and of a number of sacks, having a complicated structure.

From Nemba, motor cars are available for a distance of about 9 km. to Lake Shōji through the wooded region of the Aoki-ga-hara. The Aoki-ga-hara lava flow, spreading over a vast area, is particularly noticeable in the districts near the lakes of Seiko, Shōji and Motosu. Its gentle slope lying between lakes Seiko and Shōji is now covered with a forest growth known as the *Jukai* ("Sea of woods"). To the south, the parasitic cones of Ōmuro-yama, Yugetsuka, Nagao-yama and others appear to visitors like islands in the "Sea of woods." Formerly the lakes Seiko, Shōji and Motosu were united into one large continuous lake, and were subsequently separated by the lava flow called the Aoki-ga-hara *Marubi*.

From Nemba to Shōji, the road lies on this lava flow, affording to visitors a delightful trip through the wooded country side. Not only is Lake Shōji itself charming to visitors, but from its shore, may be had a magnificent view of Mt. Fuji. The lake is surrounded by high, precipitous mountains, except on its southern side where stands a comfortable hotel, the "Shōji," of European style, embowered in trees and beautifully situated on a promontory. Around the lake are several places of interest, Panorama Hill being especially attractive. From its top, the five lakes above mentioned are in plain view and the exquisite beauty of Lake Motosu appears at its best.

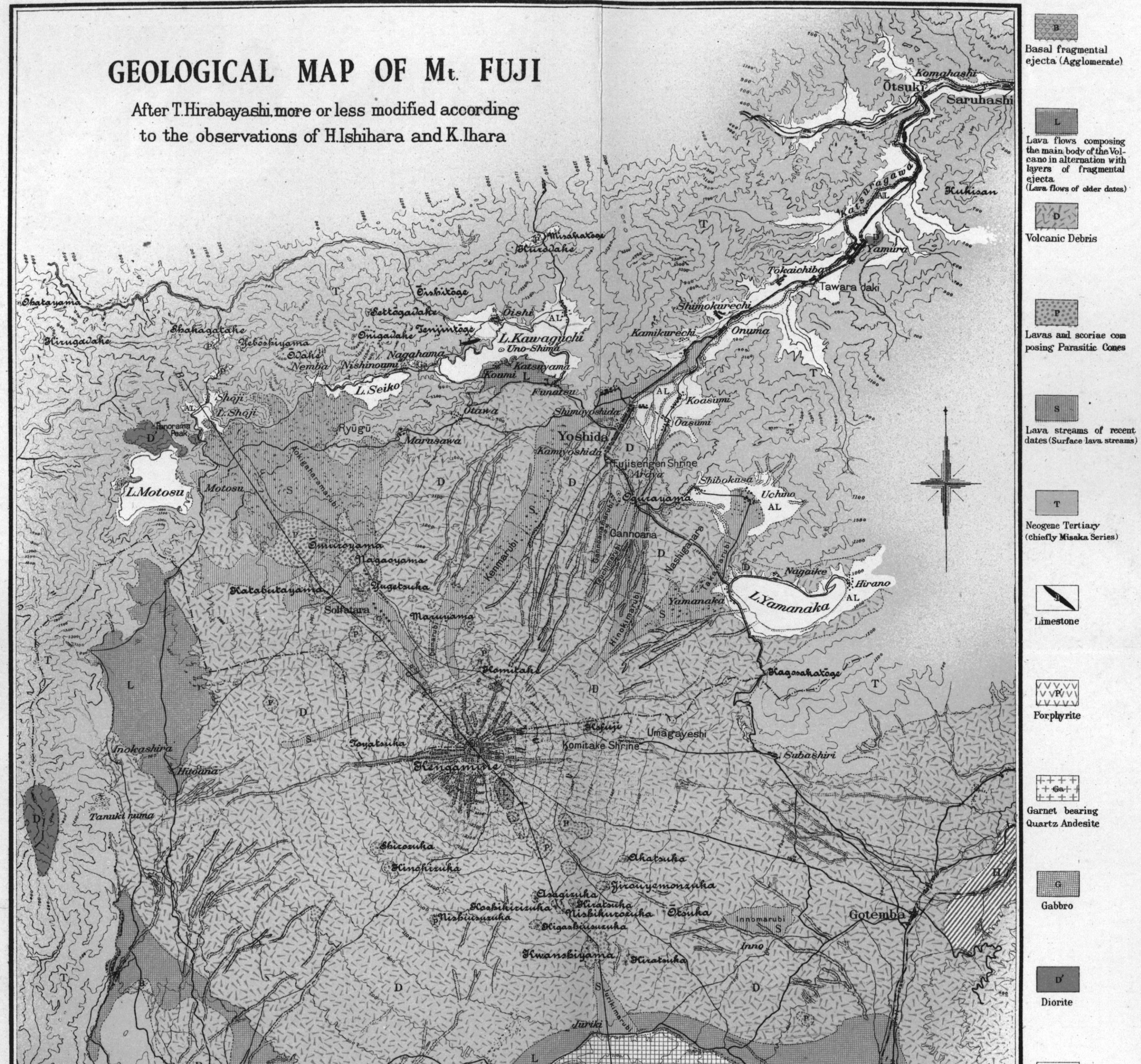
The famous *Kōri-ana* ("Ice cave") is 5 miles away from Shōji along the forest road leading to the summit of Mt. Fuji. This singular cave is 9.6 m. high and has an average width of 10.8 m., being 170 m. long. Its floor is composed of solid ice which never melts. No one knows its thickness. In it are stored silkworm eggs to prevent their premature hatching. Besides, there are a number of interesting lava tunnels, caves and sacks, such as *Kōmori-ana*, *Fugaku-Fūketsu* and the Narusawa ice-cave. Tree moulds left in the lava flow are especially attractive. They may be seen at a point about 500 m. west of the village of Narusawa.

Yoshida to Gotemba

Motor cars may be driven from Yoshida to Gotemba over the

Kagosaka pass. On the righthand side, the beautiful cone of Mt. Fuji comes into sight and the road crosses several lava streams until we reach the small village of Yamanaka. These lava streams are, beginning from the north, *Gan-ana-marubi*, *Tsuchi-marubi*, *Hinoki-marubi* and *Taka-marubi*, the first three flowing down in close association at about 3 km. southwest of Yoshida, while the last one is isolated near Yamanaka. A waterfall called Kaneyama-daki, flowering over the *Hinoki-marubi*, lava stream, may be seen on the left side at a point crossing a gully. Two parasitic cones, known as Ō-usu and Ko-usu, stand at a distance of about 1.5 m. to the southwest of Kanayama-daki. These cones each having a crater on its summit, are built up of volcanic sand and lapilli. The rough, gently sloping plain which lies between the *Hinoki-marubi* and the *Taka-marubi* is composed mainly of volcanic detritus and is called *Nashi-ga-hara*.

The flat and fertile land to the east of Nashi-ga-hara, is an old lake-bottom, and many cold springs are found here and there on its surface. Lake Yamanaka ("Among the mountains") is nearly equal in size to Lake Kawaguchi and is the only one of the five lakes with a visible outlet. Encircled by gently sloping mountains and having almost no trees around it, the lake presents an appearance quite different from that of the other lakes. It has an altitude of 982 m., a circumference of 14 km. and a depth of 24 m. Kagosaka-tōge, a pass between the two Prefectures of Shizuoka and Yamanashi, has an altitude of 115 m. above sea-level, rising 661 m. above Gotemba, 115 m. above Yamanaka, and 309 m. above Yoshida. These regions are almost barren of any kind of tree, being composed of volcanic detritus such as sand, lapilli, etc. However, the top of the pass commands a grand panoramic view of the surrounding mountains; the Misaka range far away to the north, the Ashigara-Dōshi mountain to the east, Hakone and the rugged Ashidaka volcano to the south and Mt. Fuji to the west. From the top, the car runs slowly down the steep grade, following a small gully, and then proceeds through the skirt plain, which is covered with volcanic detritus. Reaching Gotemba Station, we take the train back to Tokyo.


GEOLOGICAL MAP OF Mt. FUJI
After T. Hirabayashi, more or less modified according to the observations of H. Ishihara and K. Ihara
B Basal fragmental ejecta (Agglomerate)
L Lava flows composing the main body of the Volcano in alternation with layers of fragmental ejecta (Lava flows of older dates)
D Volcanic Debris
P Lavas and scoriae composing Parasitic Cones
S Lava streams of recent dates (Surface lava streams)
T Neogene Tertiary (chiefly Misaka Series)
Limestone
P Porphyrite
Ga Garnet bearing Quartz Andesite
G Gabbro
D' Diorite
AL Alluvium
A Volcanics from Ashidaka Volcano (Lava flows and fragmental ejecta)
H Lava flows from Hakone Volcano
IL Iwabuchi Lava
L. Kawaguchi
L. Seiko
L. Shoji
L. Motosu
L. Yamanaka
Yoshida
Gotemba
Omiya
Yoshiwara
Kambara
Yui
Numazu
Mishima
Otsuki
Saruhashi
Ashidakayama
Fujikawa
Section A.B.
Main Crater
Hoei San
Parasitic Cone
L. Shoji
Scale 1 : 200,000

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