

# **STUDIES ON THE LIMESTONE FLORA OF JAPAN AND TAIWAN PART I**

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(Received September 10, 1962)*

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## INTRODUCTION

So far as the limestone flora is concerned, it is well known that there exist more or less characteristic species to be called "calcicolous" or "calci-philous". The studies on limestone floras or vegetations can be easily found in many floristic or ecological literatures especially from Europe since the middle of the last century. In Japan the works dealing with this subject have been swelled in number especially quite recently.

My study on the limestone flora was commenced in 1954. Up to the present, most limestone districts in Japan were visited. From November 1960 to May 1961, on the other hand, I stayed in Taiwan and could make some botanical trips to the limestone districts there. Through these travels, there have been carried out the floristic researches together with the field observations, by which the characteristics of the limestone flora could be recognized. At the same time, my study was sometimes accompanied by the field work in the sense of phytosociology. It aims a vegetational comparison between limestone fields and the others, by which detection of peculiarity of the limestone communities will be possible. For analysis of speciation, cytological proce-

dures will present a useful method as well as examination of the morphological variations of plants. Whether limestone plays a rôle for chromosome aberration or not may be also an interesting problem, though I have gained little results yet.

Basing upon these directions of approach, this text is designed to be consisted of the following matters, dealing with the limestone flora in Japan and Taiwan as the whole and with its biological significance in the various senses as mentioned above. For a status of publication, it will be divided into three parts. PART I and PART II are concerned with the floristic problems in main. Chapter I and Chapter II are the introductory part for them, mentioning research history (Chapter I) and distribution of limestone fields in Japan and Taiwan (Chapter II). Each local flora is summarized in Chapter III. PART I includes these three chapters. Chapter IV deals with grouping of the floristic components of the limestone districts and its corresponding exemplification. From the taxonomical and phytogeographical viewpoint, the note-worthy components are discussed one by one in Chapter V. The general characteristics of the limestone flora in Japan and Taiwan together with comparison with serpentine floras are mentioned in Chapter VI. PART II includes these three chapters. PART III is prepared for the phytogeographical and phytosociological problems and for consideration of the general biological aspects referring to variation and speciation of plants in the limestone fields.

The word "limestone flora" used in this text is an inclusive term meaning the flora on the habitats derived from calcareous rocks, viz. calcite, chalk, dolomite, gypsum, limestone, marble, etc. So far as my own works are concerned, however, only the fields of limestone or crystalline limestone will be matter of discussion.

The present work has been carried out mainly at the University of Kyoto under the guidance of Prof. S. KITAMURA and Dr. M. TAGAWA. So I must mention my cordial thanks to them at the first place. It should be written specially that the studies of the serpentine floras of Japan done by Prof. S. KITAMURA provided the present study with numerous suggestive accounts. In these two years, my study has been promoted thanks to kind direction and encouragement of Dr. N. KOYAMA of Shinshu University. During my stay in Taiwan, I was much indebted to Prof. T. S. LIU and Prof. C. E. DeVOL of the National Taiwan University for their provision with facilities of the study. So my special thanks must be due to them. At the same time I wish to express my hearty thanks to many other botanists of Japan and Taiwan who helped me in various ways.

The materials on which the present study is based are in majority preserved in the herbarium of the University of Kyoto, and partly of Shinshu University and in others.

## CHAPTER I HISTORY OF THE STUDIES

The plants from limestone fields provide the botanists with many interesting problems. Above all, owing to its peculiarities, researches of the limestone flora have attracted many botanists of the world. Indeed they have the very inception already as long ago as 1836, when UNGER pointed out that the limestone flora was of much peculiarity in the northern Tirol of Austria, and grouped its members into three classes according to their preferences for limestone.

LOUDON (1838) and THURMANN (1849) made some interesting observations on the relation between soil condition and plant distribution. According to the former, a beech tree, *Fagus sylvatica*, which is usually growing on dry soils as chalk and limestone, is absent from west England even in calcareous rock range because of higher rainfall there and lower porosity of limestone than chalk. The latter in turn was interested in the fact that the above beech was usually calcicolous in the northern Europe while rather silicicolous in the Mediterranean side. This phenomenon seems to have led THURMANN to an opinion that the so-called calcicolous plants are only xerophilous, for driness of the calcareous soils is thought to profit the xerophilous plants under the climate of higher humidity in north Europe than that in the Mediterranean side. These observations will give some important suggestions for consideration of the nature of the calcicolous species.

Thus the investigation of limestone floras originated on one hand in the static aspect looking for its floristic peculiarities or characteristic species and on the other hand in the dynamic aspect dealing with the distributional mechanism of the calcicolous plants. In this chapter, I intend to summarize the progress in research in these two directions of approaches for convenience. Needless to mention, however, the characteristics of any flora and mechanisms controlling them should be pursued hand in hand.

### § 1. Floristic and vegetational researches

Study of the limestone flora, generally speaking, seems to have been carried out in proportion to the degree of progress in the general floristic research. In Europe and North America, numerous botanists have announced the limestone floras as what they were, while in the other parts of the world, apart from Japan, there are few works dealing with the subject.

EUROPE: It may be English botanists who best contributed to the limestone flora. They have made many informations on the floras or vegetations of the famous chalk land in particular, which forms an elusive horizon in south-eastern England. Following to the general explanation of HUDSON (1900) or TANSLEY et al (1911), on one hand, a series of the close studies of the chalk vegetation was published by ADAMSON (1922), TANSLEY (1922), TANSLEY and ADAMSON (1925, 1926), ANDERSON (1927) and HOPE-SIMPSON (1940, 1941 a b), in which they clarified the composition of chalk vegetation with regard to flowering plants, bryophytes and lichens, outline of the plant succession on

chalk lands, and chemical or physical nature of chalk downs, i. e. water content, reaction, and so on. WATT (1923, 1924, 1925, 1934 a b, and 1926), on the other hand, studied the beech woods (*Fagus sylvatica*) and the yew woods (*Taxus baccata*) on chalk lands mainly from the view point of plant succession. SALISBURY (1918), ANDERSON (1928), HOPE-SIMPSON (1938), LOCKET (1946) and others may be the other investigators of chalk vegetations around [there, while BRENCHLEY (1912), FRASER (1939) and HARVEY (1939) are specialists on the chalk flora rather in the western part of England including Wilts, Somerset and Devon. Depending upon these outcomes several popular books were also issued with references to chalk lands; for example, TANSLEY (1925), GILMOUR (1947), LOUSELY (1950) and SALISBURY (1952 b). Summarizing all of these works, the chalk lands in England may be outlined as follows. Edaphologically the soils derived from chalk, which is extremely porous rock composed of 95~99 %  $\text{CaCO}_3$ , are shallow, quickly drying and with a strongly alkaline reaction. The soil type is very similar over the entire chalk outcrops and imparts a corresponding uniformity to the vegetation. Floristically, the chalk lands are characterized by : *Aceras anthripophorum*, *Ajuga chamaepitys*, *Anacamptis pyramidalis*, *Anthyllis vulneraria*, *Asperula cynanchica*, *Bartsia odontites*, *Brassica alba*, *Briza media*, *Astragalus danicus*, *Brachypodium pinnatum*, *Bromus erectus*, *Buxus sempervirens*<sup>1</sup>, *Campanula glomerata*<sup>2</sup>, *Carlina vulgaris*, *Centaureum umbellatum*, *Cirsium acaule*, *C. eriophorum* var. *britannica*, *Daucus carota*<sup>3</sup>, *Euphrasia anglica*, *E. nemorosa*, *E. pseudokernerii*, *Fagus sylvatica*<sup>4</sup>, *Festuca ovina*<sup>5</sup>, *Filipendula hexapetala*, *Gentiana amarella*, *G. anglica*, *G. germanica*, *Helianthemum nummularium*, *Helictotrichon pratensis*, *H. pubescens*, *Heracleum sphondylium*, *Hieracium pilosella*, *Himantoglossum bircinum*, *Hippocrepis comosa*, *Hypochaeris maculata*, *Koeleria gracilis*<sup>6</sup>, *Leontodon hispidum*, *Linaria vulgaris*, *Linum alpinum* var. *anglicum*, *L. catharticum*, *Lithospermum arvense*<sup>7</sup>, *Lychnis githago*, *Myosotis arvensis*, *Ophrys apifera*, *O. fuciflora*, *O. muscifera*, *O. sphagodes*, *Orchis militaris*, *O. simia*, *O. ustulata*, *Origanum vulgare*, *Papaver rhoeas*, *Phyteuma tenerum*, *Plantago media*, *Polygala calcarea*, *Poterium sanguisorba*, *Pulsatilla vulgaris*, *Reseda lutea*, *Salvia pratensis*, *Scabiosa*

1. *Buxus microphylla* of the east Asia, which is closely related to this species, is frequently found on limestone cliffs but sometimes on granites or igneous rocks.
2. *Campanula glomerata* var. *davurica* is found on grassland in Kyushu without special connection with limestone.
3. I have never seen the carrot in the limestone fields in Japan. HIROE (1962) informed that this plant might be rather of salophytic nature in Japan.
4. The beech trees are neither dominant nor frequent in the limestone districts both in Japan and Taiwan.
5. 6. 7. The Japanese representatives of these species are never frequent in the limestone districts.
8. The eastern member of this species, ssp. *fauriei*, has not special connection with limestone both in Japan and Taiwan.
9. The closely related Japanese weed, *S. ugoensis*, which is sometimes regarded as a subspecies of this European plant, is very often found on limestone in Japan, but not restricted.

*arvensis*, *S. columbaria*, *Scleropoa rigida*, *Senecio integrifolius*<sup>8</sup>, *Seseli libanotis*<sup>9</sup>, *Taxus baccata*<sup>10</sup>, *Teucrium botrys*, *Thesium humifuscum*, *Thymus serphyllum*<sup>11</sup>, *Trifolium procumbens*, *T. dubium*, *Valerianella olitoria*, *Viola tricolor*, etc. Ecologically, the generalized succession on chalk lands is directed to the beech woods (*F. sylvatica*) or to the yew woods (*T. baccata*) in Beech system or Yew system after WATT's terminology (1926). Its pioneer stage is represented by mosses such as *Brachythecium*, *Fissidens*, *Serigera* and *Thuidium*, by grasses such as *Agrostis alba*, *Carex flacca*, *Dactylis glomerata* and *Festuca ovina*, and by herbs such as *Thymus serphyllum* and *Tussilago farfara*, while the serial stage by shrubs such as *Calluna vulgaris*, *Clematis vitalba*, *Cornus sanguinea*, *Crataegus monogyna*, *Fraxinus excelsior*, *Prunus spinosa*, *Quercus robur*, *Rhamnus catharticus*, *Rosa micrantha* and *Rubus leucostachys*.

Concerning with limestone floras or vegetations of England, MOSS (1911, 1913) and WHITE (1912) are earlier investigators. Recently HEPBURN (1942, 1955) closely studied the oolitic limestone vegetation in Northampton, making a comparison of the floristic components with those of the typical flora of the chalk grassland. On the limestone grassland of Wales, McLEAN (1938) issued a paper in regard to Worms Head off the Gower peninsular in Giamorgan. Also from Ireland, several works are found, for example, those of PRAEGER (1934) and WEBB (1947 a b). Again I refer to LOUSELY (1950) and SALISBURY (1952 b) here as dealing with the English limestone floras as the whole. LOUSELY exemplified the species listed below as the positive indicators of limestone, viz. *Anthyllis vulneraria*, *Blackstonia perfoliata*, *Brachypodium pinnatum*, *Bromus erectus*, *Campanula glomerata*, *Clematis vitalba*, *Cornus sanguinea*, *Epipactis atropurpurea*, *Filipendula hexapetala*, *Galium pumilium*, *Geranium sanguineum*, *Helianthemum nummularium*, *H. polyfolium*, *Plantago media*, *Scabiosa columbaria*, *Sorbus aria*, *Verbascum nigrum* and *Viburnum lantanum*, while SALISBURY mentioned 28 examples of the characteristic species in England, i. e. *Actaea spicata*<sup>12</sup>, *Aster linosyris*, *Cardamine impatiens*<sup>13</sup>, *Carex digitata*, *Chrysosplenium alternifolium*, *Cirsium eriophorum* var. *britannica*, *Colchicum autumnale*, *Dianthus caesiuss*, *Dryopteris villarsii*, *Dryas octopetala*<sup>14</sup>, *Gagea lutea*<sup>15</sup>, *Galium pumilium*, *Geranium sanguineum*, *Gymnocarpium robertianum*<sup>16</sup>,

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10. Likewise in the beech, the yew trees are also neither dominant nor frequent in the limestone districts both in Japan and Taiwan.
  11. *Thymus serphyllum* ssp. *quinquecostatum* is very often found on limestone in Japan, but not restricted.
  12. Its allied species, *Actaea asiatica*, is, though rarely, found in the limestone fields of Japan.
  13. This is found often in the limestone districts in Japan, but seems to be not selective on the matter of soil kinds.
  14. In Japan, *Dryas octopetala* var. *asiatica* is growing on rubbly alpine grasslands. Owing to lack of the limestone fields in the alpine region, it cannot be a member of the limestone districts of Japan.
  15. Though this plant is also in Japan, I have not yet seen it in the limestone fields.
  16. The closely related eastern species named *Gymnocarpium jessoense* is found mostly in the limestone or serpentine fields in Japan.

*Hypericum montanum*, *Koeleria valesiaca*, *Lathyrus sylvestris*, *Melica nutans*<sup>17</sup>, *Neotinea intacta*, *Polygala amara*, *P. austriaca*, *Primula farinosa*<sup>18</sup>, *Sesleria varia*, *Trinia glauca*, *Vicia sylvatica* and *Viola lutea*.

From Norwegian Lappland, COOMBE and WHITE (1951) brought rich materials on the calcareous (dolomitic) communities, in which we could find some examples of the exclusive calcicoles such as *Anthyllis vulneraria*, *Arabis hirsuta*<sup>19</sup>, *Asplenium viride*<sup>20</sup>, *Epipactis atropurpurea* and *Viola rupestris*, and those of the calcicoles such as *Carex rupestris*, *C. capillaris*<sup>21</sup>, *Dryas octopetala*<sup>14</sup>, *Parnassia palustris*<sup>22</sup>, *Salix reticulata*, *Saxifraga aizoides* and *S. oppositifolia*. Furthermore, NAUSTDAL (1931) pointed out a close relation of *Alchemilla alpina* to the calcareous soils in west Norway. And BREIEN (1932) announced that the shell bed was dominantly covered with *Anemone hepatica*<sup>23</sup>, *Fragaria vesca* and *Pyrola rotundifolia*, and that some characteristic plants including *Carex digitata*, *Crepis praemorsa*, *Gymnadenia conopsea*, *Linum catharticum*, *Melica nutans*<sup>17</sup>, *Parnassia palustris*<sup>22</sup> and *Viola riviniana* were found there.

In Sweden, HALDEN (1950) took note of *Asplenium ruta-muraria*<sup>24</sup>, a lime-demanding species in his word, occurring on calcite-granite in Södermanland.

Contributions to the Finnish limestone flora owe to PESOLA (1928, 1937, 1952, 1955), BRENNER (1930), EKLUND (1946 a b), etc. In his study of the flora of Aboland, PESOLA (1937) exemplified his grouping of the calcicolous plants made public in his preceding paper (1928) as follows.

Obligate calciphiles: *Saxifraga tridactylites*,

Calciphiles: *Arabis hirsuta*<sup>19</sup>,

Subcalciphiles: *Bromus mollis*, *Polygonatum multiflorum*, *Corylus avellana*, *Anemone ranunculoides*, *Dentaria bulbifera*, *Trifolium montanum*, *Seseli libanotis*<sup>9</sup>, *Mercularis perennis*, *Fraxinus excelsior*, *Pulmonaria officinalis*, *Melampyrum cristatum* and *Artemisia campestris*.

In addition, he regarded *Filipendula hexapetala*, which was a characteristic calcicolous plant in England, as indifferent in the matter of soil condition. Following to PESOLA's grouping, EKLUND (1946 b) also classified the vascular

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17. This is a common grass of the mountain sides in Japan. It seems not to be selective for calcareous soils.
  18. The eastern counterpart, ssp. *modesta*, is often found both on limestone and serpentine in Japan, but not exclusively.
  19. The eastern counterpart, ssp. *nipponica*, is rather silicicolous in Japan, being hardly found on the limestone fields.
  20. This is one of the alpine ferns in Japan and Taiwan, being sometimes found on limestone cliffs at lower elevation.
  21. In Japan, this sedge is known only from Mt. Yubari in Hokkaido, which is a serpentine mountain. But it is not reported that it grows on serpentine.
  22. This is often found in limestone crevices also both in Japan and Taiwan, but not exclusively.
  23. The Japanese counterpart of this species, *Anemone hepatica* var. *japonica* (= *Hepatica nobilis* var. *japonica*), is usually growing under the forests on the mountain sides, and sometimes in the limestone fields.
  24. Also both in Japan and Taiwan, this fern is conspicuously calcicolous.

plants from SW Finland with regard to degree of their relation to the calcareous habitats into six groups. According to him, the first group, "Kalkstet" plants, is represented by *Asplenium ruta-muraria*<sup>24</sup>, *Potamogeton crispus*<sup>25</sup>, *Carex flava*<sup>26</sup>, *C. capillaris*<sup>21</sup>, *Brachypodium silvaticum*<sup>27</sup>, *Cypripedium calceolus*<sup>28</sup>, *Seseli libanotis*<sup>9</sup>, *Primula farinosa*<sup>18</sup>, *Pinguicula vulgaris*<sup>29</sup>, *Inula salicina*<sup>30</sup>, etc. and the second group, "Stark kalkhold", by *Equisetum palustre*<sup>31</sup>, *Cystopteris fragilis*<sup>32</sup>, *Taxus baccata*<sup>10</sup>, *Carex caespitosa*<sup>33</sup>, *C. verna*<sup>34</sup>, *C. vaginata*<sup>35</sup>, *C. pseudocyperus*, *Gymnadenia conopsea*<sup>36</sup>, *Neottia nidus-avis*<sup>37</sup>, *Achroanthes monophyllos*<sup>38</sup>, *Arenaria serpyllifolia*<sup>39</sup>, *Actaea spicata*<sup>12</sup>, *Arabis hirsuta*<sup>9</sup>, *Parnassia palustris*<sup>22</sup>, *Vicia hirsuta*<sup>40</sup>, *Geranium robertianum*<sup>41</sup>, *Viola mirabilis*<sup>42</sup>, *Torilis anthriscus*<sup>43</sup>, *Veronica spicata*<sup>44</sup>, etc.

From Soviet Unions, I have only an announcement of the vegetation on the chalk cliffs in Ukraine, where, KOTOV (1927) said, *Allysium montanum*, *Androsacea villosa*, *Artemisia salcoides*, *Daphne sophia*, *Diplotaxis cretacea*, *Hyssopus cretaceus*, *Linaria cretacea*, *Mattiola fragrans*, *Plantago maritima*, *Scrophularia cretacea*, etc. are note-worthy.

The floristic or vegetational research in the limestone districts of middle

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25. This water plant is common in fresh streams in Japan.
  26. In Japan, *Carex flava* var. *viridula* is rarely found in Hokkaido and Honshu, but not recorded from limestone fields.
  27. This grass is sometimes found in limestone fields in Japan, but not exclusively.
  28. The closely related eastern member, *Cypripedium macranthum* (= *C. calceolus* var. *atsumori*), has no special connection with limestone in Japan.
  29. In Japan, this is one of the alpine plants, being sometimes found on the limestone walls.
  30. The eastern counterpart, var. *asiatica*, is a member of the open grasslands without special preference for calcareous soils.
  31. In Japan, this is never calcicolous.
  32. This fern is often found on limestone cliffs in Japan, but not restricted.
  33. In Japan, this sedge is a member of the moorlands.
  34. The records of its eastern counterpart, var. *microtricha*, are not from limestone fields.
  35. In Japan, *Carex vaginata* var. *petersii* is rarely found in Hokkaido and in northern Honshu. Its records are not from limestone fields.
  36. This is one of the alpine orchids in Japan, but not a member of the limestone districts.
  37. The eastern counterpart, var. *manshurica*, has no special connection with limestone.
  38. This orchid is sometimes found on limestone cliffs in Japan, but never exclusively.
  39. This is merely a common weed growing on sunny open fields both in Japan and Taiwan.
  40. This is also merely a common weed of the arable lands or open grasslands in Japan.
  41. Both in Japan and Taiwan, it grows mostly on limestone fields.
  42. Its eastern counterpart, var. *subglabra*, is often found in limestone fields, but not exclusively.
  43. The related Japanese species, *Torilis japonica*, is merely a common weed of the grassland or bushes,
  44. Though *Veronica spicata* var. *japonica* is recorded from Honshu, Kyushu and Korea, I have no materials about this plant.

and south Europe has been also actively carried out. WIERDAK (1927) analysed one of the steppe vegetation in the gypsum and lime region near Rahatyn in Galicia, and the gypsum cliff flora at Sarniki. DOMIN (1928 a b) made a detailed account on the calciphilous woodland, thicket and grassland near Prague, and a comparison between vegetations of the granitic High Tatras and of the limestone Tatras in the western Carpathians. Earlier in Germany, DRUDE (1887) paid attention to the calcareous habitat of *Carex humilis*. KVASNINAS-SAMARINAS (1926) inquired the vegetation of Mts. Kyffhausen, referring to its relation to calcareous soils. RANGE (1926) surveyed the flora of Lübeck, recording his ecological observations with lists of the calciphobes and the calciphiles. DEPPE (1928) was interested in the fact that a calcareous mountain east of Göttingen presented a wonderful remnant of the central European beech and yew woods. In Göttingen, RUHL (1952) studied a calciphilous flora on the isolated lime rich area surrounded by sandstone, and extracted about 50 species of the calciphilous plants. Besides them, VOLK (1935), GLÜCK (1935) and GILOMEN (1938) may be mentioned as the other investigators of the limestone plants in Germany. According to HORIKAWA (1952) who introduced WALTER'S work, which I could not see, *Asplenium ruta-muraria*<sup>24</sup>, *A. viride*<sup>20</sup>, *Asperula cynanchica*, *A. glauca*, *Aster linosyris*, *Coronilla emerus*, *Euphorbia sequieriana*, *Hippocrepis comosa*, *Bromus erectus*, *Sesleria caerulea*, *Teucrium montanum* and *T. scordium* are calcicolous in Germany. Also SCHIMPER (1903, 1935) teaches us that *Aster amellus*, *Hippocrepis comosa*, *Epipactis rubiginosa*, *Prunus mahaleb*, *Teucrium botrys*, *T. montanum* and *Globularia vulgaris* are found only on calcareous soils.

KLEIN (1932) referred to occurrence of *Asplenium ruta-muraria*<sup>24</sup> in the Devonian locality of Luxemburg free from Ca, and discussed its reason. OLSEN (1943) analysed the vegetation around some natural limestone glades in Allindelille of Denmark, where alternation of the vegetation was seen in the direction away from the glades like this: herbaceous zone→cornel shrubbery zone→low chlorotic beech zone→green beech zone. DELFORGE (1934) and NIHOUL (1935) should be quoted with regard to the Bergian flora. The former made an observation on effect of the soil character on plant distribution, presenting a list of the plants corresponding to the various kinds of soil within the district of 18 Entre-Sambre-et-Neuse. The latter assigned the limestone vegetations of Belgium to three associations: (1) Querceto-Fagetum, (2) *Prunum spinosae* and (3) *Brometum erecti*.

In France already in the last century, many botanists such as PLANCHON (1854), IVOLAS (1886), BONNIER (1879, 1889) and FLAHAULT (1893) paid attention on the limestone vegetations. According to FLAHAULT (1901), the note-worthy calcicolous plants of France are in the temperate districts *Anthyllis vulneraria*, *Cerasus mahaleb*, *Cirsium acaule*, *Coronilla varia*, *Globularia vulgaris*, *Helleborus foetidus*, *Hippocrepis comosa*, *Prunus spinosa*, *Teucrium botrys* and *T. montanum*, and in the Mediterranean districts *Acer monspecculanum*, *Amelanchier vulgaris*, *Asplenium ruta-muraria*<sup>24</sup>, *Cistus albidus*, *Coronilla emerus*, *C. juncea*, *Cytisus sessilifolius*, *Erica multiflora*, *Gentiana scorpius*, *Lavandula latifolia*, *Passerina dioica* and *Sesleria caerulea*. JOUAUNE (1928), LITARDIÈRE (1928), ISSLER (1938) and



DUPONT (1956) studied the vegetation of the calcareous swamp in Aisne, of the chalk cliffs at Blanc Nez, of the calcicoles in Vosges, and of the Basque-Astrian calcareous littoral region, respectively. According to LITARDIÈRE, *Brachypodium* is an exclusively calcicolous there likewise in the English chalk districts.

LITARDIÈRE (1929) phytosociologically studied Corsica, recognizing four general types of vegetation. One of them is the rock vegetation divisible into two xerophytic calcicolous subassociations: one predominated by *Brassica oleracea* var. *insularis* and the other by *Ruta divaricata*. CAMPOREALE (1955) studied the floristic composition of 'pulo' vegetation in the Cretaceous limestone district of Apulia. RIVAS-GODAY (1952) discussed more than thirty of the indicator species for the Palaeozoic limestone in Extremadura of Spain. QUEZEL (1957), referring to the limestone vegetation of the central Pyrenees, recognized several associations such as *Scrophularia pyrenaica*-*Antirrhinum sempervirens* Ass., *Pinguicula longifolia*-*Carex tenuis* Ass., *Potentilla alchemilloides*-*Asperula hirta* Ass. and *Borderea pyrenaica*-*Aquilegia pyrenaica* Ass. DEL VILLAR (1925) was concerned with the gypsum vegetation of Spain, mentioning some indicators such as *Lepidium subulatum*, *Hemisaria fruticosa* and *Frankenia veteri*. In the suburbs of Lisbon, TELES (1953) carried out a study of the grassland of *Melilotus segetalis* from the phytosociological and edaphological standpoints. Here he accepted a calcareous community with *Scorpiurus vermiculata*, *Convolvulus tricolor*, *Medicago hispida*, *Stachys hirta*, *Chrysanthemum myconis*, etc. predominating.

On the moss or lichen flora of the European limestone districts, BOULAY (1877), WATSON (1918), FREY and OCHSNER (1926), MATTICK (1932) and ROY (1932) should be referred.

AFRICA: In few floristic studies on the limestone districts of Africa, the report of GIMINGHAM and WALTON (1954) is the important one. It is an analytical result of the limestone vegetation in northern Cyrenaica. Here, they say, two endemic species, *Cyclamen rohlfsianum* and *Hypericum decaisneanum* grow in limestone crevices as chasmophytes. From the southern most of Africa, HERRE (1938) extracted some lime-loving plants including *Titanopsis setifera*. Off the mainland, LEANDRI (1952) described the vegetation of the baiotian-batonian calcareous strip of the middle part of the western Madagascar, giving a list of plants growing under each environmental condition.

NORTH AMERICA: FERNALD (1918) who made a comparison of the calcicolous flora with the silicicolous one in Newfoundland may be a pioneer in the American limestone floras. EAMES (1926) pointed out close connection of *Hedeoma hispida* with limestone throughout Connecticut and its adjacent areas. HARPER (1929) listed the plants on marble in Pickens Co. of Georgia. CARR (1939) reported the flora of a swamp in Virginia getting the lime spring water, where lime-loving plants and acid loving ones were found together. Regarding the West Indian limestone vegetation, there are found the works of GLEASON and COOK (1927), HOWARD and BRIGGS (1953) and LOVELESS and ASPREY (1957), concerning with Porto Rico, southern Cuba and Jamaica, respectively.

ASIA: In the Asiatic countries except Japan, owing to the unadvanced situation in the general floristic research, works on the limestone flora or vegetation are few. In the continental China, for instance, HOU (1954) and LEE (1957) seem to be only botanists who are interested in the peculiar connection of some plants with calcareous soils. No materials have come to my hand from the other parts of the Continent.

JAPAN and TAIWAN: In Japan, contrariwise, peculiarity of the limestone floras has been of attraction to many botanists. MAKINO (1893) already in the last century paid his attention to the habitat of *Asplenium ruta-muraria*. On his report of the localities of this fern, he mentioned that it was restricted to crevices in limestone. TAKEDA (1905) pointed out steady relation of *Asplenium ruta-muraria*, *Cyrtomium caryotideum*, *Camptosorus sibiricus*, *Boniniella ikenoi* and *Aleuritopteris krameri*. HONDA (1929) and MURAI (1934) also reported about preference of *Asplenium ruta-muraria* for limestone.

Among the members of the flowering plants, on the other hand, *Eriobotrya japonica* is a good example of the limestone species, as MIYOSHI (1925, 1926) pointed out. Surely this tree seems to be mostly restricted to the limestone districts in wild state.

Some interesting observations announced by KOIZUMI (1926, 1927, 1932) also cannot be neglected for this chapter. Probably he is the first who found limestone preserving some alpine plants in the conifer zone or in the lower elevation. He called such a case "relic frigid flora".

KAWATA (1932) introduced UNGER's grouping of the calcicolous species into three classes, i. e. (1) indifferent to calcareous soils, (2) somewhat related and (3) restricted. *Camptosorus sibiricus* was exemplified as a member of the last group. Furthermore, it is worth notice that his attention was also directed on a variety of plants growing on surface of limestone and on soils derived from it.

During that decad, SHIROFUYO (1932), KOSAKA (1932) and SASAMURA (1935) published some limestone florulas in Prov. Bingo, Prov. Bittchu and Prov. Rikuchu respectively, in the local periodicals. The characteristic species mentioned are *Camptosorus sibiricus*, *Carpinus turczaninovii*, *Forsythia japonica*, *Hypodematum glanduloso-pilosum*, *Juniperus sargentii*, *Rhodotypos scandens*, *Rubus yoshinoi*, *Spiraea yatabei* var. *latifolia*, *Youngia yoshinoi*, etc. in the first two and *Camptosorus sibiricus*, *Polystichum craspedosorum*, *Saxifraga fortunei*, *Sedum verticillatum*, etc. in the third.

However, these reports are only fragmental notes of the collected specimens or fields observations. In these ten years, the limestone floras have been explored specially. So, recently the reports on the limestone floras and vegetations of Japan are covering almost all of the main fields of the limestone districts. The localities so far investigated are listed below together with the author's names.

Table 1 Limestone districts floristically studied and authors

	Prefecture	Locality	Author
Hokkaido	Shiribeshi	Mt. Ohira	WATANABE (1956)
Honshu	Aomori	Shiriya-cape	MIZUSHIMA & MORI (1958)
	Iwate	Shimohei-gun Geibikei	SHIMIZU (1958) YOSHII & YOSHIOKA (1949)
	Fukushima	Otaki	YOSHII & YOSHIOKA (1949)
	Saitama	Chichibu district Mt. Futago Mts. Mitsumine	MORIYA (1957)
			MORIYA (1958) HARA (1956)
	Nagano	Mt. Toyokuchi  the upper Aoki-river Todai	KUBOTA (1940 a b, 1952), KOIZUMI (1952) KOIZUMI (1952) YAMAZAKI (1952)
	Shiga	Mt. Ibuki	SHIMIZU (1959 a)
	Nara	the upper Yoshino-river Kawakami-mura Mts. Omine	TERAO (1950) KOSHIMIZU (1954), TERAO (1960) SHIMIZU (1959 b)
	Okayama	Atetsu & Oga	TERAO (1955)
Hiroshima	Taishakukyo	HORIKAWA (1942), HORIKAWA & SASAKI (1959)	
Shikoku	Ehime	Mimido	TOKUI (1953), YAMANAKA & MORISHITA (1956 c)
		Onogahara	TERAO (1953), YAMANAKA & MORISHITA (1956 c)
	Tokushima	Mt. Tsurugi Tenguzuka	YAMANAKA (1954 b) YAMANAKA (1961)
	Kochi	various localities	YAMANAKA (1953, 1954 b, 1955 a b, 1956), YAMANAKA & MORISHITA (1956 a b c, 1958)
Kyushu	Miyazaki	Okuhyuga	HIRATA (1955)
	Kumamoto	Southern district	SHIMIZU (1960)

As to the lower groups of plant, the works of NAGANO and NOGUCHI (1958, 1960), NOGUCHI (1959), NOGUCHI and NAGANO (1955, 1958) and TAKAGI and NAGANO (1957), dealing with the moss floras on limestone, are not negligible.

Concerning the Taiwan limestone floras, there were no works except those of HSIEH (1936) and NAKAMURA (1941). Unfortunately, the former is merely a list of plants from the Taroko district, the representative limestone district of Taiwan, without discussing the limestone flora itself and its characteristics. The latter is a manuscript dealing with the limestone vegetation and flora around Mt. Chingshui north of Hualien, but unpublished. So far as the materials for the Taiwan limestone flora are concerned, the present text will provide the first information in various senses.

## § 2. Other related problems

When a plant is growing on limestone or lime-rich soil, it has either preference for limestone or only tolerance for it. If the other plants of the same species are also growing on limestone at least within a certain district, there will occur a question why so. The answer may be still that the species has more or less physiological preference for limestone, or else that the species is simply more tolerable or more adaptable than its competitors. In the former case the plant will grow on calcareous soils better than on siliceous ones when in culture, while in the latter case it will well grow on both kinds of soil without the competitors. In both cases, such species might be called "calcicoles". If their physiological preference for calcareous soil is detected, "calciphiles".

However, it is worth notice that most species which are calcicolous in a district are not always so in the other districts. The earlier observations of LOUDON (1838) and THURMANN (1849), who clarified the relationship between distribution and habitat of *Fagus sylvatica* in England and in the continental Europe respectively, brought the question about entity of the calcicolous plants into great discussion. The similar examples as this beech, which is exactly calcicolous in one district but silicicolous in the other, were gradually added. BONNIER (1879) listed such plants. For example, a *Larix* is excluded from calcareous soils in Switzerland and Tyrol but confined to them in Bavaria and Salzburg, while indifferent to soil kind in Carpathia. Similarly *Geum reptans* is calcicolous in Mont Blanc but silicicolous in Dauphiné. CHRIST (1879) said that the Carpathian calcicoles such as *Dryas octopetala*, *Saxifraga oppositifolia*, *Gentiana nivalis*, *G. tenella*, *G. verna*, *Erica carnea*, *Chamaeorchis alpina*, *Carex capillaris*, etc. were silicicolous in Switzerland, while *Bupleurum stellatum*, *Phaca alpina*, etc. were the reverse. FLAHAULT (1901, 1907) enumerated the plants calcicolous in northern France but not in Covenens. They are *Buxus sempervirens*, *Cirsium eriophorum*, *Clematis vitalba*, *Dianthus carthusianorum*, *Digitalis lutea*, *Echinops ritro*, *Eryngium campestre*, *Euphorbia cyparissias*, *Fagus sylvatica*, *Helianthemum vulgare*, *Helleborus foetidus*, *Juniperus communis*, *Teucrium chamaedrys* and *T. polium*. BRENCHELY (1912) made a comparison of Bedfordshire weeds with those of western England with regard to habitat, reporting that the calcifugous weeds in the former

were all more or less characteristic of chalk in the latter. Such weeds are *Bartsia odontites*, *Chenopodium album*, *Euphorbia exigua*, *E. helioscopia*, etc. According to his observation, there are few distinct chalk weeds in Bedfordshire contrary to the western counties. BIELER-CHATELAN (1927) pointed out that some well-known calcifuges such as *Eupteris aquilina*, *Castanea sativa* and *Spartium junceum* were sometimes calcicolous. In Japan, KOIZUMI (1926) observed that certain alpine plants indifferent to soil kinds could be found on limestone at the lower elevation. In the previous paper (1958), I laid stress on a distributional aspect of some selected plants, which were confined to the limestone fields in a district but indifferent to soil kinds in the others. Thus, TANSLEY (1932) already relevantly maintained that there were few species which would be strictly confined to the calcareous habitats throughout the whole distributional areas.

Now, what kind of soil conditions which limestone or chalk brings forth is effective on the distribution of "calcicoles"? This theme has been pursued by numerous botanists from the stand-point of both physical and chemical characters of the calcareous soils. The research outline on this subject is summarized in many ecological and phytogeographical textbooks such as SCHIMPER (1903, (1935), TANSLEY (1932), BRAUN-BLANQUET (1951), HORIKAWA (1952), AOKI (1954) and OOSTING (1954), and in many other papers including SALISBURY (1920), PESOLA (1928) and YOSHII (1935). Therefore I do not intend to repeat their explanations here in details. The following is only a glance over them.

The "physical theory", which attributes appearance of any calcicolous species to the physical properties of soils on which they grow, was authorized by THURMANN (1849). This was agreed by almost all of his contemporaries, and supported by HALL and RUSSEL (1911), KRAUS (1911), TANSLEY (1911), SKENE (1913), SALISBURY (1916), ROTH (1919), SCHRÖTER (1933), etc. In Japan, YAMANAKA (1952 a) and TOKUI (1953) are in favor of the "physical theory". Here I refer only to some observations of PESOLA (1928), who was specially concerned with the Finnish calcicoles. Although he put a stress on lime requirement of any calcicoles, he observed that influence of lime for plants became greater as soil moisture increased. At the same time, he pointed out that plants which were indifferent in the optimal portions would become more positive towards lime in the less favorable portions, and that indifferent plants which preferred to poorer habitats under optimal conditions would become more negative towards lime under less favorable conditions.

The "chemical theory", on the other hand, which emphasizes a certain connection of the calcicolous species with some chemical components of soils or their derived properties, was advocated by NÄGELI (1865). SALISBURY (1920) rightly considered the calcicolous species as of two groups, one composing of the plants preferable for the physical properties of calcareous soils and the other for chemical features of them. He was in opinion, however, that the former would be merely pseudo-calcicoles. Furthermore, HOPE-SIMPSON (1938) maintained that it would be impossible to consider the "physically" determined calcicoles.

Earlier, WEBER (1900) and FERNALD (1907) denied the deleteriousness of Ca itself for the calcifuges, and attributed their disappearance from calcareous soils to absence of K or superabundance of the accompanying soluble salts. SALISBURY (1916, 1918) exemplified some calcicoles such as *Fraxinus excelsior*, *Rhamnus catharticus*, *Acer campestre*, *Cornus sanguinea*, *Ligustrum vulgare*, *Sambucus nigra*, *Solanum dulcamara*, *Rubus caesius* and *Mercurialis perennis*. Though they are markedly calcicolous in dry areas, according to him, they are frequently on acid soils but in very damp or even aquatic areas, so that diluted acidity by high water content must be pointed out.

Speaking of soil acidity, most calcicoles could be regarded as alkaline or neutral plants. MASSART (1910) pointed out that *Sesleria coerulea* and *Rhamnus catharticus*, though growing usually on chalk, were also found in alkaline water with high amounts of soluble salts. WHERRY (1927) proved that the calcicolous *Sedum aizoon* grew on exactly neutral soils even if on granite. DOMIN (1928 b) was of opinion that presence of the calciphiles in the granitic areas was attributable to the neutral or very slightly acid soils. STEELE (1955) acquired a conclusion from his field observations and experiments in culture that the calcicoles were divisible at least into two groups: the first group meant the plants growing successfully on neutral soils with high Ca supply (mainly  $\text{CaCO}_3$ ) and in the fields strictly being confined to limestone, while the second group meant the plants showing a wider range of tolerance for soil conditions and in the fields being found also neutral or more acid soils with lower Ca supply. *Asperula cynanchica*, *Cystopteris fragilis*, *Echium vulgare*, *Erigeron acris*, *Iberis amara*, *Linaria elatine*, *L. spuria*, *L. minor*, *Plantago media*, *Saxifraga hypnoides*, *Scabiosa columbaria*, *Sherardia arvensis*, *Sysimbrium thalianum* and *Veronica persica* are members of the former, and *Arenaria verna*, *Asplenium viride*, *Brassica sinapis*, *Carlina vulgaris* (almost indifferent to soil composition in the continent), *Filipendula hexapetala*, *Galium mollugo*, *G. verum*, *Inula conyza*, *Juniperus communis*, *Pimpinella saxifraga* and *Senecio viscosus* are those of the latter.

Exchangeable Ca content may be another important factor controlling the distribution of the calcicolous plants. WLODECK, RALSKI and WODZIKA (1933) and TERA0 (1956 b c, 1961) advocated that the calcicoles were more or less restricted to soils conspicuously rich in exchangeable Ca. The recent works of TERA0 (1956 a b c, 1961) show us that no soil factors are more significant for occurrence of calcicoles than exchangeable Ca supply, which was measured 40.1 m.e. in mean value and 110 m.e. in maximum in the limestone districts in Japan. These values should be compared with the maximum one of 30 m.e. in the non-calcareous districts. On the basis of these measurements and those of Ca content in plant bodies, he selected "calciphilous" plants from "calcicolous" ones as this: *Asplenium ruta-muraria*, *Campthosorus sibiricus*, *Cyrtomium caryotideum*, *Aleuritopteris argentea*, *Pteris cretica*, *Asplenium scolopendrium*, *Polystichum craspedosorum*, *Chloranthus japonicus*, *Epimedium violaceum*, *Mercurialis leiocarpa*, *Bupleurum falcatum*, *Paraxeris yoshinoi*, *P. denticulata* f. *pinnatifidata*, *Hosta longipes*, *Arabis flagellosa*, *Abelia integrifolia*, *Berchemia berchemiaefolia*, *Buxus microphylla* var. *japonica*,

*Fraxinus sieboldiana*, *Lindera obtusiloba*, *Berchemia racemosa*, *Forsythia japonica*, *Carpinus turczaninowii*, *Orixa japonica*, *Smilax stans*, *Rubus yoshinoi*, *Lespedeza buergeri*, *Picrasma quassioides*, *Helwingia japonica*, *Berberis thunbergii*, *Spiraea betulifolia*, *Berchemia pauciflora*, *Securinega suffruticosa* and *Pertya glabrescens*.

Further aspect of the calcicolous plants is competition between related species for habitat. Thanks to NAEGELI (1865), CHRIST (1879), BRENCHELY (1912), TANSLEY (1917) and SALISBURY (1952 a), the following pairs can be mentioned: *Androsace pubescens*-*A. glacialis*, *Anemone alpina*-*A. sulphurea*, *Calamagrostis varia*-*C. villosa*, *Carex firma*-*C. curvula*, *Euphorbia helioscobia*-*E. exigua*, *Galium sylvester*-*G. saxatile*, *Gentiana clusii*-*G. excisa*, *Hutchinsonia alpina*-*H. brevicaulis*, *Juncus hostii*-*J. trifidus*, *Plantago media*-*P. lanceolata*, *Poa pratensis*-*P. annua*, *Primula auricula*-*P. hirsuta*, *Quercus ilex*-*Q. subra*, *Q. robur*-*Q. sessiliflora*, *Ranunculus repens*-*R. acris*, *Rhamnus catharticus*-*R. fragula*, *Rhododendron hirsutum*-*R. ferrugineus*, *Rumex crispus*-*R. acetosella*, and so on. Here the first in each pair is calcicolous and the second silicicolous. It is said that these species are usually confined to their respective soils in the regions where both occur, but indifferent to soil kinds when either of them is absent.

OLSEN (1943, 1961) attributed occurrence of the vegetation such as the chalky glades amongst the *Fagus* forest in Denmark to the result of competition between trees and herbs for nutrients. In glades there exist richer  $\text{CaCO}_3$  and poorer Fe, K and substantial N than in the surroundings. This fact results that the glades are devoid of trees, because they demand more supply of Fe and N in particular than the herbs.

Regardless to the physiological preferences for the calcareous soils, some species might be often relict on limestone merely because of their more tolerability than the others. In this respect, the conception of "relic frigid region" of KOIZUMI (1926) must be mentioned here, too. LOUSELY (1950) pointed out the presence of the relict group amongst the calcicoles as well as the groups with chemical preference and with physical preference, exemplifying *Arenaria ciliata*, *A. gothica* and *A. norwegica* as relict plants of limestone. Recently in Japan, YAMANAKA (1952 a, 1953) and YAMAZAKI (1952) emphasized the relict aspect of the calcicolous plants.

The physiological or morphological modification of plants due to calcareous habitat is one more interesting problem. From this standpoint, FLICHE and GRANDEAU (1873, 1874, 1979) made a morphological comparison of various plants which grown on chalk and on sand (or sandy clay). When grown on chalk, *Pinus pinaster* and *Castanea vesca* will stunt or die, or else will be of smaller size and with yellow leaves. Moreover, these trees grown on siliceous soils are much richer in K and poorer in lime than on calcareous soils. *Robinia pseudo-acacia*, on the other hand, though well grown on both kinds of soils, is thicker in bark, more numerous in vessel, poorer in starch amount in parenchyma, more abundant in albuminates and shorter and narrower in pod shape when grown on chalk than on sand. Chlorosis occurring in plants on calcareous soils has been studied by many students. CONTEJIAN (1881) observed chlorosis occurring in *Sarothamnus*, *Calluna*, *Ulex* and *Anthoxanthum* when

grown on chalk. Similarly OLSEN (1935) and MEVIUS (1924) found chlorosis occurred in the calcifugous plants when grown on calcareous soils. They attributed its cause to reduction of Fe absorption which resulted from presence of high content of Ca.

HILGARD (1888) observed that the oaks such as *Quercus ferruginea* and *Q. obtusifolia* would stunt when on sand or on black prairie soils but successful when on calcareous soils. MASCLEF (1892) found *Pteris aquilina* to get shorter in rhizomes, more numerous and thicker in roots, stronger in protective tissues, and obscurer in reserve parenchyma, when grown on calcareous soils than when grown on clay. According to a culture experiment of BONNIER (1894), *Ononis natrix* on soils rich in  $\text{CaCO}_3$  formed taller and less spreading tufts, broader leaves, shorter sepals, and possessed color distinct from that of the plants on soils poor in  $\text{CaCO}_3$ . HARLOW (1927) demonstrated that *Thuja occidentalis*, though no distinction in morphological characters was recognized, was more increased in weight, in strength in end compression and in rapidity of growth when grown on limestone outcrops than in bogs. In this respect, he considered *Thuja occidentalis* as a calcicole. Depending on an announcement of HARLEY (1949), the beech wood shows an increase in size, weight and root-sphere when grown on limestone. Such morphological or physiological variations might lead differentiation of some particular forms. GILOMEN (1938) detected a well defined calcicolous subspecies of *Carex curvula*. Contrary to the decidedly calcifugous mother species, this new form is said to be different from it in a great number of morphological characters as well as in ecological demands and geographical distribution. SALISBURY (1952 a) laid stress on that some of the closely related species would be often distinguishable by distinction of the ecological demands and the distributional areas even if there were few distinct morphological characters between them.

In addition, it is significant to mention about some cytological contributions to the limestone floras. In the limestone district of Schleswig-Holstein, according to ROHWEDER (1936), much higher percentage of polyploid species is detected than in the other siliceous districts. TATSUNO (1938, 1939 a b, 1950 a b, 1951) studied polyploidy in *Dumohrtiera hirsuta* (Hepaticae), reporting that its monoploid form was restricted to calcareous rocks both in Japan and Taiwan. SHIMOTOMAI and DOGISHI (1950) proved that the tetraploid of *Chrysanthemum indicum* was usually found the inland limestone district while the hexaploid in the coastal districts.



## CHAPTER II DISTRIBUTION OF THE LIMESTONE FIELDS IN JAPAN AND TAIWAN

Both in Japan and in Taiwan, there occur many limestone fields. The representative limestone districts of Japan are the following: the Oshima peninsula of Hokkaido; the Kitakami and the Abukuma mountains in Tohoku; the Chichibu district of Kanto; the Akashi mountains and Oomi in Pref. Niigata of Chubu; the Ibuki and the Suzuka mountains of Kinki; the central part of Chugoku as well as the Akiyoshi plateau; and the extending belt parallel with the medium tectonic line from the Kii peninsula through Shikoku to Kyushu. Geologically speaking, majority of the limestone formations of Japan belongs to the Permo-Carboniferous system called the Chichibu Paleozoic group. Those included in the other geological groups, though sporadically found, are almost negligible.

In Taiwan, an enormous series of limestone presents us precipitous cliffs everywhere between the Pacific and the central mountains. It is the crystalline limestone belonging to the Paleozoic group (cf. YEN, SHENG & KENG 1951; YEN 1953). On the contrary, in the western half of the island the limestone formations are scattered in a few districts and in much small scale. They are the coral limestone either of the Tertiary or of the Quaternary period. That of Kuantzlin of Pref. Tainan is an example of the former, while that of Shoushan of Pref. Kaohsiung of the latter.

On the chemical constitution of limestone both from Japan and Taiwan, the following table should be referred.

Table 2 Chemical constitution of limestone in Japan and Taiwan

Locality		Clay part	CaO	MgO	CaCO <sub>3</sub>	MgCO <sub>3</sub>	Total
		SiO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub>					
		%	%	%	%	%	%
Japan	Mt. Myojo, Pref. Niigata	0.29	55.48	0.29	99.06	0.60	99.95
	Mt. Ibuki, Pref. Shiga	0.70	55.04	0.38	98.29	0.79	99.73
	Tosayama, Pref. Kochi	0.44	55.36	0.28	98.79	0.59	99.82
	Mt. Kwaradake, Pref. Fukuoka	0.55	55.44	0.26	98.94	0.59	100.03
Taiwan	Pacific side, Pref. Hualien	0.30	55.19	0.25	98.56	0.59	99.45
	.....	1.30	54.28	0.68	96.92	1.43	99.65
	Kaohsiung, Pref. Kaohsiung	2.56	53.50	0.54	99.54	1.13	99.23

(SONOKAWA 1940)

The outline of distribution of the limestone districts mentioned above is illustrated in Fig. 1. The numerals on the map indicate each limestone district the florula of which is described in the following chapter.

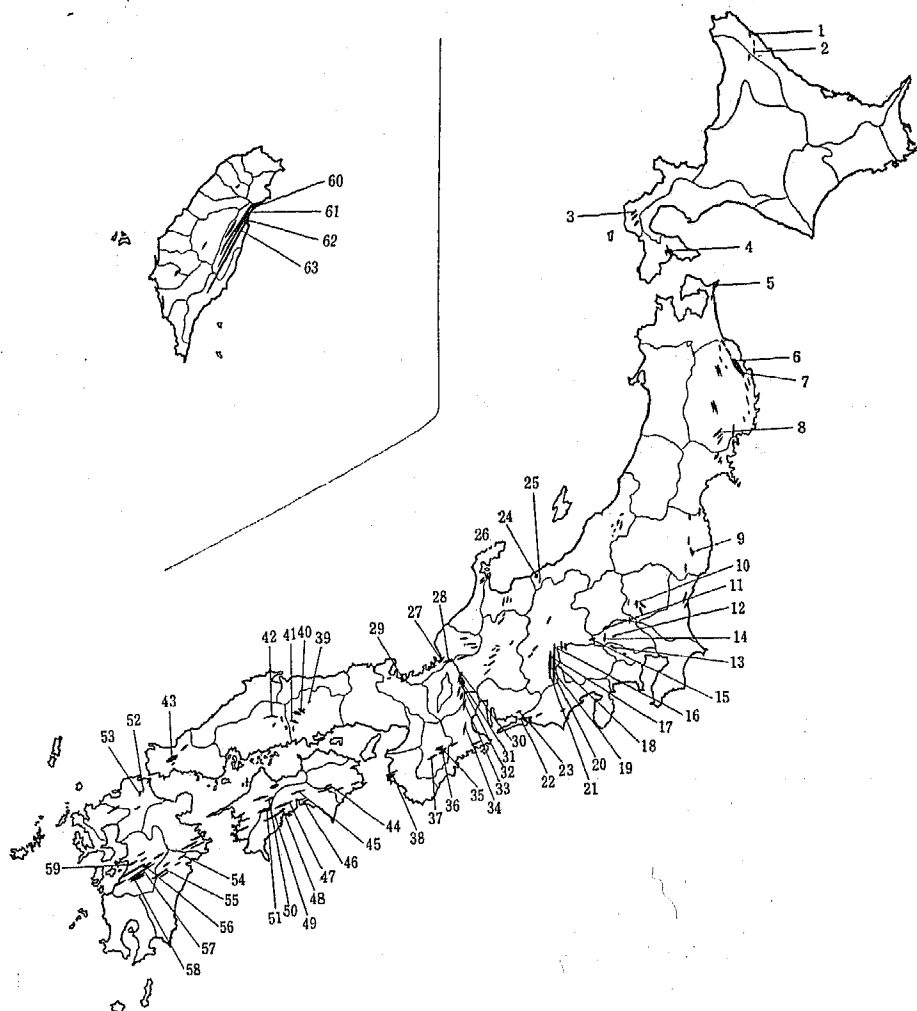


Fig. 1. Distribution of the limestone districts in Japan and Taiwan  
 Numerals indicate location of the selected fields the florulas of which  
 are described.

## The list of the limestone fields studied

**Hokkaido**

- 1 Menashidomari, Prov. Kitami
- 2 Iwaya, Prov. Kitami
- (3) Mt. Ohira, Prov. Shiribeshi
- 4 Kamiiso, Prov. Oshima

**Honshu**

- (5) Shiriya-cape, Pref. Aomori
- 6 Akka, Pref. Iwate
- 7 Iwaizumi, Pref. Iwate
- 8 Geibikei, Pref. Iwate
- 9 Mt. Ootakine, Pref. Fukushima
- 10 Izurusan, Pref. Tochigi
- (11) Mt. Futago, Pref. Gunma
- 12 Mt. Buko, Pref. Saitama
- 13 Nippara, Pref. Tokyo
- 14 Mts. Mitsumine, Pref. Saitama
- 15 Jumonji-pass, Pref. Saitama
- 16 Mt. Kamanashi, Pref. Nagano
- 17 Mt. Shiraiwa, Pref. Nagano
- 18 Todai, Pref. Nagano
- 19 Mt. Jizodake, Pref. Nagano
- 20 Mt. Toyokuchi, Pref. Nagano
- 21 Upper Aoki-river, Pref. Nagano
- 22 Mt. Ishimaki, Pref. Aichi
- 23 Shinshiro, Pref. Aichi
- 24 Mt. Kurohime, Pref. Niigata
- 25 Mt. Myojo, Pref. Niigata
- 26 Kanetsuri, Pref. Toyama
- 27 Kanagasaki, Pref. Fukui
- 28 Tone, Pref. Fukui
- 29 Matsuodera, Pref. Kyoto
- 30 Mt. Ibuki, Pref. Shiga
- 31 Mt. Ryozen, Pref. Shiga
- 32 Gongen-dani, Pref. Shiga
- 33 Mt. Fujiwara, Pref. Mie

- 34 Foot of Mt. Nonobori, Pref. Mie
- (35) Shiraya, Pref. Nara
- 36 Kashiwagi, Pref. Nara
- 37 Mts. Oomine, Pref. Nara
- 38 Yura, Pref. Wakayama
- 39 Katsuyama, Pref. Okayama
- 40 Niimi, Pref. Okayama
- (41) Nariwa, Pref. Okayama
- 42 Taishaku-kyo, Pref. Hiroshima
- 43 Akiyoshi, Pref. Yamaguchi

**Shikoku**

- (44) Mt. Tsurugi, Pref. Tokushima
- 45 Mt. Ishidate, Pref. Kochi
- 46 Ryugado, Pref. Kochi
- 47 Tosayama, Pref. Kochi
- 48 Mt. Yokogura, Pref. Kochi
- 49 Mt. Torigata, Pref. Kochi
- 50 Mimido, Pref. Ehime
- 51 Onogahara, Pref. Ehime

**Kyushu**

- 52 Hirao-dai, Pref. Fukuoka
- 53 Mt. Kawaradake, Pref. Fukuoka
- 54 Mt. Dodake, Pref. Miyazaki
- 55 Mt. Shiraiwa, Pref. Miyazaki
- 56 Itsuki-mura, Pref. Kumamoto
- 57 Mt. Noke-eboshi, Pref. Kumamoto
- 58 Konose-mura, Pref. Kumamoto
- 59 Mt. Ryuho, Pref. Kumamoto

**Taiwan**

- 60 Mt. Chingshui, Pref. Hualien
- 61 Chingshui to Chongde, Pref. Hualien
- 62 Tailuko, Pref. Hualien
- 63 Tienchang-cliff, Pref. Hualien

Remarks : The number with parenthesis means the district where I have not yet visited.

### CHAPTER III LIMESTONE LOCAL FLORAS OF JAPAN AND TAIWAN

The present chapter aims to describe the limestone local floras of 63 selected fields designated in the previous chapter, under the respective article. Every article includes a topographical outline of the district concerned, a short statement of the vegetation and a list of the vascular plants. The plants listed are only those actually detected from limestone habitats by my own field observations, or else those exactly recorded as inhabiting them in the related publications. The limestone habitats include, (A) crevices in escarpment of limestone, (B) rocky or gravelly stands where growth of the plants are influenced from presence of limestone within their root spheres, and (C) fields composed of only calcareous soils derived from the surrounding limestone. Such differences of habitat are indicated by the signs added to the specific names, viz. A, B and C, respectively. The specific names in bold face mean the species specially note-worthy from taxonomical and phytogeographical view-point. These species will be discussed one by one in PART II or III.

So far as the Japanese flora is concerned, the plant names used are mainly quoted from the works of TAGAWA (1959, Ferns), of KITAMURA, MURATA and HORI (1957, Sympetalous herbs), of KITAMURA and MURATA (1961, Choripetalous herbs), of KITAMURA and OKAMOTO (1958, Trees & shrubs) and of OHWI (1953, Monocotyledons), but sometimes from my own treatments. Regarding the Taiwan flora, the lists of MASAMUNE (1936, 1954) are main sources of the plant names though my own opinion will be often proposed.

The plants are in every case arranged in the order of Pteridophyta, Gymnospermae, Choripetalae, Sympetalae and Monocotyledonae. The ferns are mentioned merely alphabetically as the whole. The other groups are arranged depending on the Engler's system concerning the family, and within the family the plants are disposed alphabetically.

#### HOKKAIDO

##### 1. Menashidomari (Prov. Kitami)

There is a wasted small limestone hill, an old quarry, at 10km northwest of Esashi of Prov. Kitami and about 1 km far from the coast. The sparsely dotted herbaceous vegetation with *Artemisia montana* abundant is predominantly observable on this gravelly hillside. Shrubs such as *Alnus* and *Salix* are invading into this area here and there, forming bushes along the marginal part.

<i>Asplenium trichomanes</i>	A	var. <i>ianthes</i>	B
<i>Equisetum arvense</i>	B	<i>Thalictrum minus</i>	
<i>Populus maximowiczii</i>	B	var. <i>hypoleucum</i>	A
<i>Salix hultenii</i>		var. <i>stipellatum</i>	A
var. <i>angustiloba</i>	B	<i>Schizandra chinensis</i>	B
<i>Alnus maximowiczii</i>	B	<i>Chelidonium majus</i>	
<i>Polygonum cuspidatum</i>	B	ssp. <i>asiaticum</i>	B
<i>Cerastium caespitosum</i>		<i>Arabis lyrata</i>	

ssp. kantschatica	A	var. canescens	B
A. stelleri		var. elata	B
var. japonica	AB	Ligustrum tschonoskii	B
Sedum aizoon		Plantago asiatica	B
ssp. kantschaticum	A	Asperula odorata	AB
Rubus phoenicorasius	B	Artemisia montana	B
Geranium thunbergii	B	Eupatrium chinense	
Euonymus alatus		ssp. sachalinense	B
f. striatus	B	Petasites japonicus	B
Impatiens textori	B	Picris hieracioides	
Vitis coignetiae	B	ssp. japonica	B
Viola grypceras	B	Sonchus oleraceus	B
Aralia cordata	B	Taraxacum hondoense	B
A. elata		Poa radula	B

## 2. Iwaya (Prov. Kitami)

On the way from Utanobori to Sakkuru-toge, a series of the low hills, 20m or so high above the plain, are met with, a corner of which is constructed by the mesozoic limestone. Here appears a poor vegetation represented by *Sorbus alnifolia* and *Euonymus planipes* on the rubbly land. A few plants inhabit the crevices in limestone.

Asplenium trichomanes	A	Euphorbia sieboldiana	B
Phyllitis scoropendrium	A	Euonymus planipes	B
Woodsia polystichoides	A	Daphne jezoensis	B
Cucubalus baccifera		Ligustrum tschonoskii	B
var. japonicus	B	Asperula odorata	B
Moehringia lateriflora	B	Galium boreale	
Cardamine impatiens	A	var. kantschaticum	B
Sedum aizoon	A	Artemisia montana	B
ssp. kantschaticum		Senecio vulgaris	B
Saxifraga sachalinensis	A	Allium victorialis	
Sorbus alnifolia	B	var. platyphylla	B

## 3. Mt. Ohira (Prov. Shiribeshi)

Around the summit of Mt. Ohira (1190m elev.), northwest of the Oshima-peninsula, there are seen outcrops of limestone. According to WATANABE (1956), the limestone flora here includes the following note-worthy plants.

<b>Asplenium kobayashii</b>		Aconitum yuparense	
A. <b>ruta-muraria</b>		Anemone stolonifera	
A. trichomanes		Thalictrum foetidum	
A. <b>viride</b>		ssp. glabrescens	
Juniperus nipponica		Trollius riederianus	
Thesium refractum		var. japonicus	
Cerastium mitsumorense		<b>Draba igarashii</b>	
var. mitsumorense		Thlaspi japonicum	
var. ovata		Saxifraga sachalinensis	
Minuartia verna		Dryas octopetala	
var. japonica		var. asiatica	
Silene repens		Potentilla dickinsii	

P. nivea	Crepis hokkaidoensis
Astragalus adsurgens	<b>Leontopodium hayachinense</b>
A. membranaceus	var. miyabeana
As A. yezoensis.	Taraxacum platypectidum
Gentiana auriculata	Poa hayachinensis
Cynanchum atratum	Carex tenuiformis
Thymus serphyllum	Lloydia serotina
ssp. quinquecostatus	Tofieldia coccinea
Campanula dasyantha	As <i>T. nutans</i> .
Artemisia laciniata	Gymnadenia conopsea

Furthermore he noted the following plants from a cliff at the foot.

Asplenium trichomanes	ssp. kikubuki
Polystichum craspedosorum	S. sachalinense
Trautvetteria japonica	Potentilla dickinsii
Arabis lyrata	Conioselinum filicinum
ssp. kamtschatica	Tripetaleia bracteata
Draba igarashii	Patrinia gibbosa
Sedum aizoon	<b>Adenophora pereskiaefolia</b>
ssp. kamtschaticum	var. moiwana
Saxifraga fortunei	Taraxacum platypectidum
S. fusca	Calamagrostis sachalinensis

#### 4. Kamiiso (Prov. Oshima)

The central part of Kamiiso-cho situated about 20km northwest of Hakodate is occupied by mass of the Paleozoic limestone. I took both ways in this district for a survey of the limestone flora; one along the Hekirichi river on both sides of which limestone outcrops are continuously found and the other through the Garo-mine, about 7km northwest of the Kamiiso station.

In the former case, limestone is hardly covered by vegetation owing to cutting for construction of a new road in these years. However, *Dennstaedtia wilfordii*, *Boehmeria spicata*, *Agastache rugosa* and *Artemisia keiskeana* are very frequently encountered on them. In the latter case, observation was made especially on humid calcareous fields as well as on occasional outcrops of limestone along the mountain pass. *Carpinus cordata*, *Fagus crenata*, *Cercidiphyllum japonicum*, *Acer mono*, *Aesculus turbinata*, etc. form a deciduous mixed forest there, under which various shrubs and herbs are growing. The floristic list from these fields is as below.

Adiantum pedatum	B C	P. tripterion	B C
Coniogramme intermedium	B C	Cephalotaxus harringtonia	
Dennstaedtia wilfordii	A	ssp. nana	B
<b>Gymnocarpium jessoense</b>	B C	Carpinus cordata	B
Phyllitis scoropendrium	A	Fagus crenata	B
Polystichopsis standishii	B C	Morus bombycis	B C
P. amabilis	B C	Behmeria spicata	A
Polystichum craspedosorum	A	Polygonum cuspidatum	B C
P. retorsopaleaceum		Cerastium caespitosum	C
var. coraiense	B C	Cercidiphyllum japonicum	B

<i>Actaea asiatica</i>	B C	<i>Trigonotis guilielmi</i>	C
<i>Clematis stans</i>	B C	<i>Agastache rugosa</i>	A
<i>Glaucidium palmatum</i>	B C	<i>Ajuga yezoensis</i>	C
<i>Thalictrum minus</i>		<i>Chelonopsis moschata</i>	C
var. <i>hypoleucum</i>	B C	<i>Prunella vulgaris</i>	
<i>Arabis serrata</i>		ssp. <i>asiatica</i>	C
var. <i>glauca</i>	A	<i>Phyryma leptostachya</i>	
<i>Astilbe thunbergii</i>		ssp. <i>asiatica</i>	C
var. <i>congesta</i>	B C	<i>Plantago vulgaris</i>	C
<i>Chrysosplenium flagelliferum</i>	A	<i>Asperula odorata</i>	B C
<i>Hydrangea paniculata</i>	B	<i>Lonicera morrowii</i>	B
H. <i>serrata</i>		<i>Sambucus racemosa</i>	
ssp. <i>yesoensis</i>	B	ssp. <i>kamtschatica</i>	
<i>Saxifraga fortunei</i>		var. <i>miquelii</i>	B
var. <i>incisolobata</i>	A	<i>Weigela hortensis</i>	B
var. <i>yezoensis</i>	A	<b><i>Adenophora pereskiaefolia</i></b>	
<i>Aruncus dioicus</i>		var. <i>moiwana</i>	
var. <i>tenuifolius</i>	A B	f. <i>petrophila</i>	A
<i>Rubus crataegifolius</i>	B	With retorse rough hairs on veins	
R. <i>phoenicorasius</i>	B	of leaves beneath.	
<i>Spiraea miyabei</i>	A	<i>Artemisia keiskeana</i>	A
<i>Desmodium racemosum</i>	B C	A. <i>moschata</i>	B C
<i>Vicia unijuga</i>	C	<i>Aster scabra</i>	C
<i>Pachysandra terminalis</i>	B	<i>Cacalia hastata</i>	
<i>Rhus ambigua</i>	B	ssp. <i>orientalis</i>	B C
<i>Euonymus alatus</i>		<i>Carpesium triste</i>	C
f. <i>striatus</i>	B	<i>Eupatrium chinense</i>	
<i>Acer mono</i>	B	ssp. <i>sachalinense</i>	B C
<i>Aesculus turbinata</i>	B	<i>Erigeron annuus</i>	B C
<i>Vitis coignetiae</i>	B	<i>Picris hieracioides</i>	
<i>Actinidia polygama</i>	B	ssp. <i>japonica</i>	B C
<i>Viola grypoceras</i>		<i>Solidago virgaurea</i>	
f. <i>pubescens</i>	A	ssp. <i>asiatica</i>	B C
<i>Circaea erubescens</i>	C	<i>Calamagrostis sachalinensis</i>	C
<i>Epilobium cephalostigma</i>	A	<i>Miscanthus sinensis</i>	B C
<i>Bupleurum longiradiatum</i>		<i>Allium tuberosum</i>	B C
f. <i>elatius</i>	A	<i>Smilacina japonica</i>	B C
<i>Heracleum lanatum</i>	C	<i>Streptopus amplexifolius</i>	
<i>Sanicula chinensis</i>	C	var. <i>papillatus</i>	C
<i>Tracherospermum asiaticum</i>	B	<i>Trilium smallii</i>	C
<i>Cynanchum caudatum</i>	C		

## HONSHU

## 5. Shiriya cape (Pref. Aomori)

Around the cape Shiriya at the northeasternmost corner of Honshu, there sporadically appear some limestone areas. Although I have not yet visited here, the noteworthy plants of these limestone fields can be listed as below thanks to MIZUSHIMA and MORI (1958 a b).

<i>Asplenium ruta-muraria</i>	A	<i>Gymnocarpium jessoense</i>	A
<i>Camposorus sibiricus</i>	A	As <i>G. robertianum</i> var. <i>longulum</i> .	

Cyrtomium falcatum	A	var. tachiroei	A
Polystichum craspedosorum	A	Sedum aizoon	
Juniperus conferta	A	var. latifolium	A
<b>J. sargentii</b>	A	Saxifraga fortunei	
As <i>J. sinensis</i> var. <i>sargentii</i> .		var. purpurea	A
Thalictrum minus, a form	A	<b>Hypericum yezoense</b>	A
<b>Berberis amurensis</b>		Primula farinosa	
var. <b>japonica</b>	A B	ssp. modesta	A
Much abundant in limestone area.		Lonicera strophophora	A
<b>Sisymbrium luteum</b>	A	<b>Adenophora pereskiaefolia</b>	
Rhodiola rosea		var. <b>moiwana</b>	A

## 6. Akka (Pref. Iwate)

Some extended limestone veins lie almost continuously over about 40km from Okawame to Iwaizumi in the northeastern part of Pref. Iwate, being almost in parallel to the coastal line and 15~20 km far from it. They result exposed limestone everywhere around the district. Many cliffs, rubbly slopes and ridges present us such interesting plants as reported in my previous papers (SHIMIZU 1958). Here my field work was mainly concerned with the districts around Akka and Iwaizumi both in Shimohei-gun. The floristic and vegetational outlines of them will be mentioned separately in this and the following article.

In the neighbourhood of Akka, the low limestone hills to 500m over sea level stand on the north and south sides of the Akka-river. The vegetation is roughly represented there by *Pinus densiflora* and *Quercus dentata* forming light forests at ridges and slopes respectively. *Betula schmidtii*, *Quercus serrata*, *Picrasma quassioides*, *Tilia japonica*, *T. maximowicziana* f. *yesoana*, *T. nozircicola*, *Fraxinus sieboldiana*, etc. are the subordinate members of these forests. The plants recognized in these areas are:

<b>Asplenium ruta-muraria</b>	A	Anemone flaccida	A
<b>Camptosorus sibiricus</b>	A	Aquilegia buergeriana	A
Dennstaedtia wilfordii	A	<b>Thalictrum foetidum</b>	
<b>Gymnocarpium jessoense</b>	A	var. <b>iwatense</b>	A
Polystichum craspedosorum	A	T. minus	
Pinus densiflora	A B	var. hypoleucum	A B
<b>Juniperus rigida</b>	A B	<b>Berberis amurensis</b>	
Populus sieboldii	A	var. <b>japonica</b>	A B
Betula schmidtii	B	Philadelphus satsumi	A
Corylus sieboldiana	B	Aruncus dioicus	
Quercus dentata	B	var. tenuifolius	A
Q. serrata		Potentilla dickinsii	A
var. donarium	B	Rosa multiflora	A
var. serrata	B	<b>Spiraea nipponica</b>	A B
Buckleya lanceolata	B C	<b>Astragalus membranaceus</b>	B C
Dianthus superbus	A	Lespedeza buergeri	A B
Arabis serrata		Pueraria lobata	B C
var. japonica	A B	Wisteria brachybotrys	A



<i>Linum stelleroides</i>	B	<i>Platycodon grandiflora</i>	A B
<i>Euphorbia</i> sp.	B	<i>Artemisia japonica</i>	B
<i>Picrasma guassioides</i>	B	A. <i>keiskeana</i>	A B
<i>Euonymus alatus</i>		A. <i>montana</i>	A B
f. <i>striatus</i>	A	A. <i>schmidtiana</i>	A
E. <i>sieboldianus</i>	A	<i>Aster ageratoides</i>	
<i>Ampelopsis brevipedunculata</i>	B	ssp. <i>ovatus</i>	A B
<i>Tilia japonica</i>	B	A. <i>dubius</i>	B C
T. <i>maximowicziana</i>		<i>Atractylodes japonica</i>	A
f. <i>yesoana</i>	B	<b><i>Chrysanthemum zawadskii</i></b>	A B
T. <i>× noziricola</i>	B	<i>Ixeris chinensis</i>	
<b><i>Hypericum yezoense</i></b>	A	ssp. <i>strigosa</i>	C
<i>Bupleurum longiradiatum</i>		<i>Leibnitzia anandria</i>	A
f. <i>elatus</i>	A	<i>Leontopodium japonicum</i>	A B
<i>Seseli ugoensis</i>	A B	<i>Solidago virgaurea</i>	
<i>Fraxinus sieboldiana</i>	A B	ssp. <i>asiatica</i>	A
<i>Gentiana scabra</i>		<i>Youngia denticulata</i>	A B
var. <i>buergeri</i>	B C	<i>Melica nutans</i>	B
<i>Cynanchum atratum</i>	C	<i>Miscanthus sinensis</i>	A B C
<i>Ajuga ciliata</i>		<b><i>Allium splendens</i></b>	A
var. <i>villosior</i>	B	A. <i>tuberosum</i>	A
<i>Thymus serphyllum</i>		<i>Hosta longipes</i>	A B
ssp. <i>quinquecostatus</i>	A	<i>Lilium maculatum</i>	A B C
<i>Phtheirospermum japonicum</i>	A	<i>Smilax sieboldii</i>	B
<i>Galium verum</i>		S. <b><i>vaginata</i></b>	
var. <i>trachycarpum</i>	A B	var. <i>stans</i>	A B
<b><i>Adenophora pereskiaefolia</i></b>		<b><i>Tofieldia coccinea</i></b>	
var. <i>moiwana</i>		var. <i>akkana</i>	A B
f. <i>linearifolia</i>	A B	<i>Veratrum maackii</i>	
f. <i>moiwana</i>	A B	var. <i>japonicum</i>	B
f. <i>petrophila</i>	A B		

### 7. Iwaizumi (Pref. Iwate)

In the district surrounding Iwaizumi, we find some mountains wholly constructed by limestone, where there are grasslands on lime-leached red soil, sparse bushes standing on rubbly dry slopes and poor colonies on cliffs. I was mainly concerned with Mt. Ureira, 625m, Mt. Kakeyama, 382m, and the interlocated lower hills. Similarly in Akka, *Pinus densiflora*, *Quercus dentata* together with *Q. nipponica*, *Tilia*-group and moreover *Acer mono* are the most dominant trees. *Spiraea nipponica* and *Lespedeza*-group are much flourishing on sunny rubbly slopes devoid of arborous woods. The plants recognized on these sunny slopes and on sunny cliffs are:

<b><i>Aleuritopteris argentea</i></b>	A	<i>Betula</i> sp.	A
<b><i>Asplenium ruta-muraria</i></b>	A	<i>Corylus sieboldiana</i>	B
<b><i>Camptosorus sibiricus</i></b>	A	<i>Quercus dentata</i>	B
<i>Pinus densiflora</i>	A B	<i>Morus bombycis</i>	A
<b><i>Juniperus rigida</i></b>	A	<i>Buckleya lanceolata</i>	B
J. <i>sargentii</i>	A	<i>Dianthus superbus</i>	A

<i>Clematis apiifolia</i>	B	<i>Seseli ugoensis</i>	A B
<i>Pulsatilla cernua</i>	A	<i>Spuriopimpinella calycina</i>	B
<b><i>Thalictrum foetidum</i></b>		<i>Lysimachia clethroides</i>	B
var. <i>iwatense</i>	A	<i>Fraxinus sieboldiana</i>	B
T. <i>minus</i>		?F. <i>japonica</i>	
var. <i>hypoleucum</i>	A	var. <i>stenocarpa</i>	B
<b><i>Berberis amurensis</i></b>		<i>Gentiana scabra</i>	
var. <i>japonica</i>	A B	var. <i>buergeri</i>	C
<i>Arabis serrata</i>		<i>Cynachum caudatum</i>	B
var. <i>japonica</i>	A B	<i>Lithospermum officinale</i>	
<i>Sedum aizoon</i>	A	ssp. <i>erythrorhizon</i>	B
<i>Philadelphus satsumi</i>	B	<i>Agastache rugosa</i>	C
<i>Kerria japonica</i>	B	<i>Ajuga ciliata</i>	
<i>Potentilla dickinsii</i>	A	var. <i>villosior</i>	B
<i>Rosa multiflora</i>	A	<i>Isodon inflexus</i>	B
<i>Rubus crataegifolius</i>	B	I. <i>japonicus</i>	B
R. <i>parvifolius</i>	B	<i>Thymus serphyllum</i>	
R. <i>pungens</i>	A	ssp. <i>quinquecostatum</i>	A
<i>Sorbus alnifolia</i>	B	<i>Melampyrum ciliare</i>	A
<b><i>Spiraea nipponica</i></b>	A B	<i>Pedicularis resupinata</i>	B
<i>Astragalus adsurgens</i>	A B	<i>Phtheirospermum japonicum</i>	A B
<i>Lespedeza bicolor</i>		<i>Galium verum</i>	
var. <i>bicolor</i>	A B	var. <i>trichocarpum</i>	A B
var. <i>kinashii</i>	A B	<i>Viburnum dilatatum</i>	B
L. <i>buergeri</i>	A B	<i>Patrinia scabiosaefolia</i>	B
<i>Pueraria lobata</i>	B	<b><i>Adenophora pereskiaefolia</i></b>	
<i>Vicia unijuga</i>	B	var. <i>moiwana</i>	
<i>Wisteria brachybotrys</i>	B	f. <i>linearifolia</i>	A
<i>Linum stelleroides</i>	B	f. <i>moiwana</i>	A
<i>Zanthoxylum piperitum</i>	B	f. <i>petrophila</i>	A
<i>Picrasma quassioides</i>	B	A. <i>remotiflora</i>	A
<i>Polygala japonica</i>	A B	A. <i>triphylla</i>	
<i>Euphorbia pekinensis</i>		ssp. <i>aperticampanulata</i>	B
var. <i>japonica</i>	B	<i>Platycodon grandiflora</i>	B
<i>Rhus chinensis</i>	A B	<i>Achillea sibirica</i>	C
<i>Celastrus orbiculatus</i>		<i>Artemisia japonica</i>	B
var. <i>strigillosus</i>	B	A. <i>keiskeana</i>	A B
<i>Staphylea bumalda</i>	B	A. <i>schmidtiana</i>	A
<i>Acer mono</i>	B	<i>Aster ageratoides</i>	
<i>Berchemia racemosa</i>	A	ssp. <i>leiophyllus</i>	B
<i>Vitis congesta</i>	A	<i>Atractylodes japonica</i>	B
V. <i>flexuosa</i>	B	<b><i>Chrysanthemum zawadskii</i></b>	A B
<i>Tilia japonica</i>	B	Almost corresponding to var.	
T. <i>maximowicziana</i>		<i>latilobum.</i>	
f. <i>yesoana</i>	B	<i>Cirsium nipponicum</i>	B
T. <i>× noziricola</i>	B	<i>Inula salicina</i>	B
<b><i>Hypericum yezoense</i></b>	B	<i>Leibnitzia anandria</i>	A B
<i>Viola grypoceras</i>	A B	<i>Leontopodium japonicum</i>	B
<i>Aralia cordata</i>	A	<i>Saussurea sugimurai</i>	A B
<i>Bupleurum longiradiatum</i>		<i>Serratula coronata</i>	
f. <i>elatius</i>	A B		

ssp. insularis	B	Spodiopogon sibiricus	A
Syneilesis palmata	B	<b>Allium splendens</b>	A B
Youngia denticulata	A B	A. tuberosum	A B
Calamagrostis arundinacea		Hosta longipes	B
var. brachytricha	A	Smilax sieboldii	B
Festuca ovina		<b>S. vaginata</b>	
var. coreana	B	var. stans	B
Melica nutans	B	Veratrum maackii	
M. onoei	A	var. japonicum	B
Miscanthus sinensis	A B	Epipactis thunbergii	B

In shady and somewhat humid areas, for example, around a limestone cave named Ryusenkutsu, the vegetation is different from the above sunny and dry fields. The ferns such as *Asplenium varians*, *Camptosorus sibiricus* and *Polystichum craspedosorum* are much remarkable in limestone crevices, while *Laportea macrostachya*, *Cimicifuga acerina*, *Cardamine leucantha*, *Kerria japonica*, *Alangium platanifolium* var. *trilobum* and *Helwingia japonica* are predominantly growing. The plants detected around there are as below.

<i>Asplenium varians</i>	A	var. tenuifolius	A B
<b>Camptosorus sibiricus</b>	A	<i>Kerria japonica</i>	A B
<i>Dennstaedtia wilfordii</i>	A	<i>Rubus pungens</i>	B
<b>Gymnocarpium jessoense</b>	A	<i>Lespedeza buergeri</i>	A B
<i>Polystichum craspedosorum</i>	A	<i>Zanthoxylum piperitum</i>	B
<i>Pyrrosia linearifolia</i>	A	<i>Picrasma quassioides</i>	B
<i>Chloranthus japonicus</i>	B	<i>Rhus ambigua</i>	B
<i>Carpinus cordata</i>	B	<i>Euonymus alatus</i>	
C. tschonoskii	B	f. striatus	A B
<i>Zelkova serrata</i>	B	E. oxyphyllus	B
<i>Boehmeria spicata</i>	A B	<i>Staphylea bumalda</i>	B
<i>Laportea macrostachya</i>	A B	<i>Acer mono</i>	B
<i>Pilea hamaoi</i>	A	A. cissifolium	B
<i>Aquilegia buergeriana</i>	B	<i>Viola grypceras</i>	A
<i>Cimicifuga acerina</i>	B	<i>Alangium platanifolium</i>	
C. japonica	B	var. trilobum	B
<i>Ranunculus ternatus</i>		<i>Cryptotaenia canadensis</i>	
var. quelpaertensis	B	ssp. japonica	B
<i>Thalictrum minus</i>		<i>Osmorhiza aristata</i>	B
var. hypoleucum	A	<i>Cornus kousa</i>	B
<i>Chelidonium majus</i>		<i>Helwingia japonica</i>	A B
ssp. asiaticum	A B	<i>Fraxinus sieboldiana</i>	B
<i>Cardamine leucantha</i>	A B	<i>Callicarpa japonica</i>	B
<b>Sisymbrium luteum</b>	A	<i>Sambucus racemosa</i>	
<i>Deutzia gracilis</i>	A	ssp. sieboldiana	B
<i>Philadelphus satsumi</i>	A B	<i>Artemisia keiskeana</i>	A B
<i>Rodogersia podophylla</i>	A	<i>Aster ageratoides</i>	
<i>Saxifraga fortunei</i>		ssp. leiophyllus	A B
var. incisolobata	A	<i>Syneilesis palmata</i>	A B
<i>Aruncus dioicus</i>		<i>Youngia denticulata</i>	A B

Hosta longipes	A	S. <b>vaginata</b>	
Smilax sieboldii	B	var. <b>stans</b>	B

### 8. Geibikei (Pref. Iwate)

A tributary of the river Kitagami, named Satetsu-gawa, penetrates the Paleozoic limestone formation in the southern part of Pref. Iwate, forming a vale overhanged by cliffs on both the banks. This is the valley of Geibikei, situated about 15km northeast of Ichinoseki. There are rich in cliffs and rubbly slopes along the valley with distance of about 2.5 km east to west. Over this valley a plateau composed of red earth is extended. YOSHII and YOSHIOKA (1949) gave a botanical glance towards these areas and recorded 25 species of the vascular plants.

The data on the floristic composition of a selected small area will serve to acquire an outlined knowledge of the flora. From an involuntarily selected area of 1m square on the shady cliff, for example, which was inhabited by mosses in major part, *Camptosorus sibiricus*, *Dennstaedtia wilfordii*, *Polystichum craspedosorum*, *Laportea macrostachya*, *Saxifraga fortunei* var. *incisolobata*, *Acer carpinifolium* were listed. In the case of the sunny dry cliff, on the other hand, *Clematis stans*, *Philadelphus satsumi*, *Kerria japonica*, *Spiraea nipponica*, *Euonymus alatus* f. *striatus*, *Acer mono*, *Bupleurum longiradiatum* f. *elatus*, *Artemisia keiskeana*, *Aster ageratoides* ssp. *leiophyllus*, *Miscanthus sinensis* and *Carex* sp. were recorded within the same area in size. *Polystichum craspedosorum* and *Spiraea nipponica* are the dominant plants in these shady and sunny areas, respectively. The detailed list of the plants detected is as below.

<b>Asplenium ruta-muraria</b>	A	<i>Aphananthe aspera</i>	B
A. <b>varians</b>	A	<i>Zelkova serrata</i>	A B
<i>Athyrium nipponicum</i>	B	<i>Brousonettia kazinoki</i>	B
<b>Camptosorus sibiricus</b>	A	<i>Boehmeria spicata</i>	A B
<i>Coniogramme intermedium</i>	B	<i>Elatostemma umbellatum</i>	
<i>Dennstaedtia wilfordii</i>	A B	var. <i>majus</i>	A
<i>Polystichum craspedosorum</i>	A	<i>Laportea macrostachya</i>	B
<i>Cephalotaxus harringtonia</i>		<i>Buckleya lanceolata</i>	B
ssp. <i>nana</i>	B	<i>Stellaria media</i>	A
<i>Pinus densiflora</i>	A B	<i>Cercidiphyllum japonicum</i>	B
<b>Juniperus rigida</b>	A B	<i>Cimicifuga acerina</i>	B
<i>Chloranthus japonicus</i>	B	<i>Clematis stans</i>	A B
<i>Juglans mandshurica</i>		<i>Thalictrum filamentosum</i>	A
ssp. <i>sieboldiana</i>	B	T. <b>minus</b>	
<i>Carpinus cordata</i>	B	var. <i>hypoleucum</i>	A B
C. <b>laxiflora</b>	B	<i>Akebia quinata</i>	B
C. <b>tschonoskii</b>	B	A. <b>trifoliata</b>	B
<i>Corylus sieboldiana</i>	B	<b>Berberis amurensis</b>	
<i>Quercus dentata</i>	A B	var. <b>japonica</b>	A B
Q. <b>mongolica</b>		<i>Epimedium glandiflorum</i>	
var. <i>grosseserrata</i>	B	var. <i>thunbergianum</i>	B
Q. <b>serrata</b>	B	<i>Parabenzoin praecox</i>	B

Sedum aizoon	A	f. elatius	A B
Astilbe thunbergii		Chamaele decumbens	A B
var. congesta	B	Cryptotaenia canadensis	B
Schizophragma hydrangeoides	B	Seseli ugoensis	A B
Philadelphus satsumi	AB	Cornus macrophylla	B
Somewhat tomentose on leaves		Helwingia japonica	B
beneath.		Fraxinus japonica	
Saxifraga fortunei		var. stenocarpa	B
var. incisolobata	A	F. sieboldiana	B
Aruncus dioicus		Syringia reticulata	B
var. tenuifolius	A B	Trachelospermum asiaticum	A B
Kerria japonica	A B	Callicarpa japonica	A B
Prunus jamasakura	B	Melampyrum ciliare	B
P. verecunda	A B	Galium pogonanthum	A
Rubus parvifolius	B	G. verum	
Sorbus alnifolia	B	var. trachycarpum	A B
<b>Spiraea miyabei</b>	A B	Paederia scandens	
<b>S. nipponica</b>	A B	var. mairei	B
Stephanandra incisa	A B	Viburnum dilatatum	A B
Lespedeza bicolor		Valeriana flaccidissima	B
f. acutifolia	A B	<b>Adenophora pereskiaefolia</b>	
Wisteria brachybotrys	A B	var. <b>moiwana</b>	
Orixa japonica	A B	f. <b>petrophila</b>	A
Zanthoxylum piperitum	A B	A. triphylla	
Picrasma quassioides	A B	ssp. aperticampanulata	A
Polygala japonica	B	Campanula punctata	A B
Euphorbia adenochlora	B	Artemisia keiskeana	A B
Rhus ambigua	A B	Aster ageratoides	
Celastrus orbiculatus	B	ssp. leiophyllus	A B
Euonymus alatus		Atractylodes japonica	B
f. striatus	A B	Cacalia farfaraefolia	
E. oxyphyllus	B	var. bulbifera	B
Staphylea bumalda	B	Leibnitzia anandria	A
Acer carpinifolius	A B	Syneilesis palmata	A
A. matsumurae	B	Youngia denticulata	A
A. mono	B	Y. japonica	A B
Meliosma myriantha	A B	Melica nutans	A B
Impatiens textori	B	Miscanthus sinensis	A B
<b>Rhamnus costata</b>	A B	Carex conica	B
R. japonica		Carex sp.	A
var. decipiens	A B	Hosta longipes	A
Tilia japonica	A B	Polygonatum lasianthum	B
Actinidia polygama	A B	Smilax sieboldii	A B
<b>Hypericum yezoense</b>	A	<b>S. vaginata</b>	
Viola grypoceras	A	var. <b>stans</b>	A B
V. kurilensis	A	<b>Tofieldia coccinea</b>	
Alangium platanifolium		var. <b>geibiensis</b>	A
var. trilobum	B	Dioscorea tokoro	B
Bupleurum longiradiatum			

### 9. Mt. Ootakine (Pref. Fukushima)

A carst district basing upon the Paleozoic limestone is seen on the west side of Mt. Ootakine, the highest peak of the Abukuma mountain range, to 1193m in altitude. Similar to the other carst districts, the plateau waving between 750m and 870m over sea level forms a vast grassland. There colonies appear here and there and rocks of limestone project over the land. On the margin of the plateau, cliffs are often found. YOSHII and YOSHIOKA (1949) published a sketch on the vegetation of the present area, recording *Camptosorus sibiricus*, *Polystichum craspedosorum*, *Polygala tatarinowii*, etc. from crevices in limestone. My observation was done on the cliffs and their rubbly but somewhat humid foots around Sendai-taira, the southernmost corner of this area, in particular. The plants detected are as follows.

<i>Asplenium kobayashii</i>	A	<i>Saxifraga fortunei</i>	
A. varians	A	var. incisolobata	A
<i>Camptosorus sibiricus</i>	A	S. fusca	
<i>Dryopteris polylepis</i>	B	var. kikubuki	A
<i>Polystichum craspedosorum</i>	A	<i>Schizophragma hydrangeoides</i>	A
<i>Pyrrosia linearifolia</i>	A	<i>Orixa japonica</i>	A B
<i>Chloranthus serratus</i>	B	<i>Zanthoxylum piperitum</i>	A B
<i>Zelkova serrata</i>	B	<i>Acer carpinifolius</i>	B
Seedlings,		<i>Impatiens textori</i>	B
<i>Boehmeria spicata</i>	A	<i>Alangium platanifolium</i>	
<i>Laportea bulbifera</i>	A B	var. trilobum	B
L. macrostachya	A B	<i>Panax japonicus</i>	B
<i>Urtica laetevirens</i>	A	<i>Callicarpa japonica</i>	B
<i>Berberis amurensis</i>		<i>Asperula odorata</i>	B
var. japonica	B	<i>Aster ageratoides</i>	
<i>Cardamine leucantha</i>	A B	ssp. leucantha	B
<i>Philadelphus satsumi</i>	A	<i>Ligularia stenocephala</i>	B

### 10. Izurusan (Pref. Tochigi)

A famous temple called Izurusan at northwest of Tochigi-shi is located between the hillis on the flanks of which limestone is to some extent exposed. Owing to the dense forest developing on the hills as well as on the precinct of the temple, the limestone vegetation is provided with a rather humid aspect. *Cephalotaxus harringtonia*, *Hydrangea involucrata*, *Kerria japonica*, *Orixa japonica*, *Acer carpinifolium*, *Alangium platanifolium* var. *trilobum* and *Aucuba japonica* are its important members here.

The plants detected from the limestone habitats are as below.

<i>Asplenium varians</i>	A	<i>Hypodematium fauriei</i>	
<i>Athyrium squamigerum</i>	A	(SEKIMOTO 1934 a, as <i>Dryopteris</i>	
<i>Camptosorus sibiricus</i>	A	<i>crenata</i> )	
<i>Cyrtomium caryotideum</i>	B	<i>Polystichum craspedosorum</i>	A
C. fortunei	A B	P. tsussimense	A
<i>Dennstaeditia wilfordii</i>	A B	<i>Pteris cretica</i>	A
<i>Dryopteris lacera</i>	B	<i>Cephalotaxus harringtonia</i>	B

Boehmeria nivea		var. laevis	B
ssp. nipononivea	B	Orixa japonica	B
Pilea japonica	B	Acer carpinifolium	B
Polygonum filiforme	B	A. mono	B
Stellaria monosperma		Alangium platanifolium	
var. japonica	B	var. trilobum	
Berberis thunbergii	A	Aucuba japonica	B
Lindera obtusiloba	B	Trachelospermum asiaticum	A
Deutzia gracilis	A	Cacalia farfaraefolia	
Hydrangea involucrata	B	var. bulbifera	B
H. serrata	B	Chrysanthemum boreale	B
Saxifraga cortusaefolia	A	Carex morrowii	B
S. fortunei		Hosta longipes	A
var. incisolobata	A	<b>Smilax vaginata</b>	
Schizophragma hydrangeoides	B	var. stans	B
Kerria japonica	B	(SERIMOTO 1934 b, as <i>S. stans</i> )	
Pourthiaea villosa		Iris japonica	B

### 11 Mt. Futago (Pref. Gunma)

Mt. Futago consisted of two peaks, Nishidake (1165m elev.) and Higashidake (997m elev.), is rich in huge limestone cliffs and rubbly slopes especially at upper elevation. Though I have not yet visited here, the species found on cliffs and slopes, according to MORIYA (1958), are as follows.

? <b>Aleuritopteris krameri</b>	Potentilla dickinsii
<b>Asplenium ruta-muraria</b>	<b>Prunus incisa</b>
<b>Camptosorus sibiricus</b>	var. <b>bukosanensis</b>
Dennstaedtia wilfordii	Sorbus alnifolia
<b>Gymnocarpium jessoense</b>	var. submollis
Polystichum craspedosorum	S. gracilis
Salix bakko	<b>Spiraea nipponica</b>
<b>Betula chichibuensis</b>	Lespedeza cyrtobotrya
Fagus japonica	var. cyrtobotrya
Quercus mongolica	var. kawachiana
var. grosseserrata	Zanthoxylum piperitum
Ulmus laciniata	Picrasma quassioides
Aconitum japonicum	Polygala japonica
Thalictrum minus	Callitriche japonica
var. stipellatum	Tithymalus sp.
(= <i>T. chionophyllum</i> )	Acer mono
Arabis serrata	f. dissectum
var. japonica	A. rufinerve
<b>Sisymbrium luteum</b>	Meliosma tenuis
Sedum aizoon	Euonymus alatus
Hydrangea paniculata	var. alatus
Parnassia japonica	var. rotundatus
Philadelphus satsumi	E. oxyphyllum
var. nikoensis	Berchemia pauciflora
Saxifraga fortunei	Tilia japonica
f. rubifolia	Daphne sp.

Bupleurum longiradiatum	Adenophora divaricata
f. elatius	A. nikoensis
Peucedanum multivittatum	f. petrophila
Rhododendron kaempferi	Aster viscidulus
var. angustifolium	<b>Anaphalis sinica</b>
R. wadanum	var. sinica
Tritomodon subsessilis	var. viscosissima
Fraxinus sieboldiana	Leontopodium japonicum
var. angustata	Saussurea amabilis
Tylophora aristolochioides	<b>Senecio furusei</b>
Isodon inflexus	Hosta longipes
Melampyrum laxum	Lilium maximowiczii
var. nikkoense	f. tenuifolium
Pedicularis resupinata	Tofieldia coccinea
Galium kinuta	var. kondoii
Lonicera mochizukiana	Veratrum maackii
L. ramosissima	var. japonicum
var. fudzimoriana	(= var. <i>reymondianum</i> )
Weigela decora	

## 12. Mt. Buko (Pref. Saitama)

Mt. Buko (1336m elev.) presents us extended limestone habitats at ridges and on northern slopes in particular at middle to upper elevation. Owing to the plantation of *Cryptomeria japonica* and *Chamaecyparis obtusa* on these slopes, there is recognized generally a closed vegetation so far as the forest floor is concerned. Here limestone is favorable for the bushes with *Parabenzoin praecox*, *Kerria japonica*, *Orixa japonica*, *Staphylea bumalda* and *Helwingia japonica* abundant. The sunny limestone ridges, on the other hand, are characterized by the sparse bushes composing of *Clematis stans*, *Spiraea nipponica*, *Zabelia integrifolia*, etc. and the cliffs are inhabited by some chasmophytic plants including calcicolous ones.

The recent floristic research of Mt. Buko is due to MORIYA (1953) and MORIYA and Koyama (1954, 1955, 1956 a b, 1957, 1958). Depending on these materials and my own collections, the vascular plants detected on limestone habitats are listed as below.

Adiantum pedatum	B	Chloranthus serratus	B
<b>Asplenium ruta-muraria</b>	A	<b>Salix kenoensis</b>	A
A. varians	A	<b>Betula chichibuensis</b>	B
<b>Camptosorus sibiricus</b>	A	Corylus sieboldiana	B
Coniogramme intermedium	B	Boehmeria paraspicata	B
Cyrtomium fortunei	B	Pilea japonica	A
Dennstaedtia wilfordii	A	Buckleya lanceolata	B
Dryopteris polylepis	B	Aconitum sp.	A B
<b>Hypodematium fauriei</b>	A	Cimicifuga acerina	A
Phegopteris decursive-pinnata	B	C. simplex	B
Polystichum craspedosorum	A	Clematis stans	A
Selaginella tamariscina	A	Thalictrum minus	
Chamaecyparis obtusa	B	var. stipellatum	A
Juniperus rigida	B		



<i>Akebia trifoliata</i>	B	<i>f. elatius</i>	B
<b>Berberis amurensis</b>		<i>Spuriopimpinella calycina</i>	B
var. <b>japonica</b> (MORIYA 1953)		<i>Helwingia japonica</i>	B
B. <i>thunbergii</i>	A B	<i>Rhododendron dilatatum</i>	B
<i>Epimedium grandiflorum</i>		<i>Primula reinii</i>	
var. <i>thunbergianum</i>	B	var. <i>brachycarpa</i>	A
<i>Lindera umbellata</i>	B	<i>Syringa reticulata</i>	B
<i>Parabenzoin praecox</i>	B	<i>Fraxinus sieboldiana</i>	B
<i>Deutzia gracilis</i>	A	<i>Gentiana scabra</i>	B
D. <i>scabra</i>	A	<i>Isodon kameba</i>	A
<i>Hydrangea hirsuta</i>	B	<i>Salvia nipponica</i>	B
H. <i>involuta</i>	B	<i>Pedicularis resupinata</i>	B
H. <i>scandens</i>	B	<i>Conandron ramondioides</i>	A
H. <i>serrata</i>	A	<i>Callicarpa japonica</i>	B
<i>Parnassia foliosa</i>		<i>Galium kinuta</i>	A B
ssp. <i>nummularia</i>	A B	<i>Abelia spathulata</i>	B
<i>Philadelphus satsumi</i>	B	<b><i>Zabelia integrifolia</i></b>	B
<i>Saxifraga fortunei</i>		<i>Adenophora divaricata</i>	A
var. <i>incisoloata</i>	A	A. <b><i>pereskiaefolia</i></b>	
<i>Schizophragma hydrangeoides</i>	B	var. <b><i>moiwana</i></b>	
<i>Aruncus dioicus</i>		f. <b><i>petrophila</i></b>	A
var. <i>tenuifolius</i>	B	A. <i>remotiflora</i>	A
<i>Filipendula multijuga</i>	B	A. <i>takedai</i>	A
<i>Kerria japonica</i>	B	<b><i>Anaphalis sinica</i></b>	A B
<b><i>Prunus incisa</i></b>		<i>Artemisia keiskeana</i>	A
var. <b><i>bukosanensis</i></b>		<i>Aster ageratoides</i>	
(MORIYA and KOYAMA 1958)		ssp. <i>leiophyllus</i>	
<i>Rubus palmatus</i>		<i>Cacalia delphiniifolia</i>	B
var. <i>coptophyllus</i>	B	<i>Chrysanthemum makinoi</i>	B
<b><i>Spiraea nipponica</i></b>	A B	<i>Leontopodium japonicum</i>	A
<i>Desmodium racemosum</i>	B	<i>Pertya robusta</i>	B
<i>Wisteria brachybotrys</i>	B	<i>Serratula coronata</i>	
<i>Orixa japonica</i>	B	ssp. <i>insularis</i>	B
<i>Zanthoxylum piperitum</i>	B	<i>Youngia denticulata</i>	A
<i>Euonymus oxyphyllus</i>	B	<i>Hakonechloa macra</i>	A
<i>Staphylea bumalda</i>	B	<i>Oplismenus undulatifolius</i>	
<i>Acer carpinifolius</i>	B	var. <i>japonica</i>	B
A. <i>palmatum</i>		<i>Carex lasiolepis</i>	A
ssp. <i>matsumurae</i>	B	(MORIYA and KOYAMA 1955)	
<i>Meliosma tenuis</i>	B	C. <i>multifolia</i>	A
<i>Berchemia pauciflora</i>	B	(MORIYA and KOYAMA 1955)	
<b><i>Rhamnus costata</i></b>	B	C. <i>siderosticta</i>	B
R. <i>japonica</i>		<i>Dioscorea nipponica</i>	B
var. <i>decepiens</i>	B	<i>Hosta longipes</i>	A
<i>Ampelopsis brevipedunculata</i>	B	<b><i>Lilium bukosanense</i></b>	A
<i>Stachyurus praecox</i>	B	<i>Polygonum lasianthum</i>	B
<i>Daphne kamtschatica</i>		<i>Smilax sieboldii</i>	B
var. <i>jezoensis</i>	A	S. <b><i>vaginata</i></b>	
<i>Alangium platanifolium</i>		var. <i>stans</i>	B
var. <i>trilobum</i>	B	<i>Tricyrtis hirta</i>	A
<i>Angelica polymorpha</i>	A	<i>Gymnadenia cucullata</i>	A
<i>Bupleurum longiradiatum</i>			

## 13. Nippara (Pref. Tokyo)

Some great inapproachable vertical cliffs of limestone are overhanging the Nippara river at the northwestern corner of Tokyo prefecture. Likewise in the other cases, there develop many limestone caves at the foot of those cliffs. The largest one of them is the so-called Nippara-cave, where the tourists can easily come near and in thanks to construction of a leading road for excursion. My research was mainly concerned with the neighbourhood of this cave but the field not destroyed by these visitors. Here on the cliff some chasmophytic or epiphytic plants such as *Pteris cretica*, *Pyrrosia linearifolia*, *Deutzia gracilis*, *Lespedeza buergeri*, etc. are sporadically recognized, while on the rubbly slope light bushes with *Orixa japonica*, *Staphylea bumalda*, *Acer mono* and *Alangium platanifolium* var. *trilobum* dominant. The detected vascular plants are as follows.

<i>Adiantum monochlamys</i>	A	<i>Wisteria brachybotrys</i>	B
<b><i>Aleuritopteris krameri</i></b>	A	<i>Geranium wilfordii</i>	B
<b><i>Asplenium ruta-muraria</i></b>	A	<i>Orixa japonica</i>	B
A. <i>varians</i>	A	<i>Zanthoxylum piperitum</i>	B
<b><i>Camptosorus sibiricus</i></b>	A	<i>Rhus ambigua</i>	B
<b><i>Cyrtomium caryotideum</i></b>	A	<i>Euonymus alatus</i>	
C. <i>fortunei</i>	A	<i>f. striatus</i>	B
<i>Dennstaedtia wilfordii</i>	A	<i>Staphylea bumalda</i>	B
<b><i>Hypodematium fauriei</i></b>	A	<i>Acer mono</i>	B
<i>Polystichum craspedosorum</i>	A	<i>Vitis flexuosa</i>	B
<i>Pteris cretica</i>	A	<i>Hypericum kinashianum</i>	A
<i>Pyrrosia linearifolia</i>	A	<i>Alangium platanifolium</i>	
<i>Selaginella tamariscina</i>	A	var. <i>trilobum</i>	B
<i>Torreya nucifera</i>	B	<i>Hedera rhombea</i>	A B
<i>Chlorantus serratus</i>	B	<i>Bupleurum longiradiatum</i>	
<i>Boehmeria spicata</i>	A	<i>f. elatius</i>	A
<i>Pilea</i> sp.	A	<i>Cornus macrophylla</i>	B
<i>Euptelea polyandra</i>	B	<i>Helwingia japonica</i>	B
<i>Clematis stans</i>	A	<i>Trachelospermum asiaticum</i>	A B
<i>Thalictrum minus</i>		<i>Isodon longitubus</i>	B
var. <i>hypoleucum</i>	A	<i>Galium kinuta</i>	B
<i>Akebia trifoliata</i>	B	<b><i>Anaphalis sinica</i></b>	A
<i>Berberis thunbergii</i>	B	<i>Aster ageratoides</i>	
<i>Sedum aizoon</i>	A	ssp. <i>leiophyllus</i>	A
<i>Deutzia gracilis</i>	A	<i>Artemisia keiskeana</i>	A
<i>Philadelphus satsumi</i>		<i>Chrysanthemum boreale</i>	A
var. <i>nikoensis</i>	B	C. <i>makinoi</i>	A B
<i>Hydrangea involucrata</i>	B	<i>Youngia denticulata</i>	A
<i>Saxifraga fortunei</i>		<i>Miscanthus sinensis</i>	A B
var. <i>incisolobata</i>	A	<i>Hosta longipes</i>	A
<i>Kerria japonica</i>	A B	<i>Smilax sieboldii</i>	B
<i>Potentilla dickinsii</i>	A	<b>S. <i>vaginata</i></b>	
<b><i>Spiraea nipponica</i></b>	A	var. <i>stans</i>	A
<i>Lespedeza buergeri</i>	A B	<i>Tricyrtis</i> sp.	A

#### 14. Mts. Mitsumine (Pref. Saitama)

Mts. Mitsumine, located in the western district of Pref. Saitama, is a series of mountain ridges running from north to south between 1500m and 2000m above sea level. One of its main peaks is Mt. Shiraiwa, where exposed rocks and rubbly places of limestone are found here and there.

Recently HARA (1956) published a botanical sketch around there in which *Betula chichibuensis* was described. Depending on his report and my own observation, the plants detected from limestone habitats are as below.

Asplenium varians	A	Euonymus melananthus	B
<b>Camptosorus sibiricus</b>	A	Berchemia pauciflora	B
Polystichum craspedosorum	A	<b>Rhamnus costata</b>	B
<b>Woodsia glabella</b>	A	R. japonica	
<b>Salix kenoensis</b>	A	var. decipiens	B
<b>Betula chichibuensis</b>	B	Daphne kamtschatica	
B. corylifolia	B	var. jezoensis	B
B. ermani	B	Epilobium amurense	B
B. grossa	B	Galium kinuta	B
Aconitum kobushiensis	A	Patrinia triloba	
<b>Berberis amurensis</b>		var. palmata	A
var. japonica	A	<b>Adenophora pereskiaefolia</b>	
Deutzia gracilis	A	var. moiwana	
D. uniflora	A	f. petrophila	A
Parnassia foliosa		Anaphalis margaritacea	B
ssp. nummularia	A	<b>A. sinica</b>	A B
Ribes maximowicziana	A	Leontopodium japonicum	A
Saxifraga fortunei		Ligularia stenocephala	A
var. incisolobata	A	Juncus maximowiczii	A
Rosa acicularis	A	<b>Smilax vaginata</b>	
Spiraea chamaedrifolia	A B	var. stans	B
S. japonica	A	Tofieldia coccinea	
Hedysarum ussuriensis	A	var. kondoi	A

#### 15. Jumoji-pass (Pref. Saitama)

The so-called Jumoji-toge (2100m elev.) stands on the border line between both prefectures of Saitama and Nagano. Although the pure forest of *Tsuga diversifolia* covers the major part of the neighbourhood, it is sometimes interrupted by enormous limestones highly projected over the ridges. Such limestones will be inhabited by many peculiar plants which are never seen anywhere in their surrounding regions. The plants recorded from the surface of two separated limestones of such, one (1700m) situated north and the other (1800m) northeast of the Jumoji-pass, are as follows.

<b>Asplenium capillipes</b>	A	Abies homolepis	B
A. ruta-muraria	A	Picea polita	A
A. viride	A	Tsuga diversifolia	B
<b>Camptosorus sibiricus</b>	A	<b>Salix kenoensis</b>	A B
<b>Gymnocarpium jessoense</b>	A	<b>Betula chichibuensis</b>	A B
Polystichum craspedosorum	A	Aconitum parahakonense	A B
<b>Woodsia glabella</b>	A	Clematis stans	A

<i>Thalictrum minus</i>		<i>Halenia corniculata</i>	A B
var. <i>stipellatum</i>	A	<i>Pedicularis resupinata</i>	A B
<b><i>Berberis amurensis</i></b>		<i>Veronicastrum sibiricum</i>	
var. <b><i>bretschneideri</i></b>	A	var. <i>japonicum</i>	B
<i>Arabis serrata</i>		<i>Galium kinuta</i>	B
var. <i>japonica</i>	A	<i>Rubia chinensis</i>	
<i>Sedum aizoon</i>	A	var. <i>glabrescens</i>	A
<i>Deutzia gracilis</i>	A	<i>Patrinia triloba</i>	
<i>Saxifraga fortunei</i>		var. <i>palmata</i>	A
var. <i>incisolobata</i>	A	<i>Adenophora divaricata</i>	A B
<b><i>Potentilla fruticosa</i></b>		?A. <i>nikoensis</i>	A
var. <b><i>mandshurica</i></b>	A	A. <i>remotiflora</i>	A B
<b><i>Spiraea nipponica</i></b>	A	<i>Anaphalis margaritacea</i>	B
<i>Hedysarum ussuriensis</i>	A	A. <b><i>sinica</i></b>	A
<i>Geranium eriostemon</i>		<i>Artemisia keiskeana</i>	A
var. <i>reinii</i>	A	A. <i>pedunculosa</i>	B
<b><i>Rhamnus costata</i></b>	A	<i>Leontopodium japonicum</i>	A
R. <i>japonica</i>		<i>Pertya glabrescens</i>	B
var. <i>decipiens</i>	A	<i>Solidago virgaurea</i>	
<i>Viola biflora</i>	A	ssp. <i>asiatica</i>	A
V. <i>shikokiana</i>	A	<i>Diarrhema japonica</i>	B
Leaves pubescent on both sides.		<i>Melica onoei</i>	B
<i>Bupleurum longiradiatum</i>		<i>Carex lanceolata</i>	A
f. <i>elatius</i>	A	C. <i>longerostata</i>	A
<i>Seseli ugoensis</i>	A	<i>Hosta longipes</i>	A
<i>Tilingia tachiroei</i>	A	<i>Streptopus streptopoides</i>	
<i>Fraxinus sieboldiana</i>	B	var. <i>japonicus</i>	B
<b><i>Gentiana contorta</i></b>	A	<i>Tofieldia coccinea</i>	
(SATAKE 1955)		var. <i>kondoii</i>	A
G. <i>zollingeri</i>	A	<i>Veratrum maackii</i>	
		var. <i>japonicum</i>	A

#### 16. Mt. Kamanashi (Pref. Nagano)

When wandering in Mt. Kamanashi (2116.5m elev.), one of the northernmost peaks of the chain of Akashi Mountains, we can sometimes meet with sunny and dry ridges of limestone though in small scales. Whenever in such cases, *Clematis stans*, *Berberis amurensis* var. *japonica* and *Spiraea nipponica* are predominantly and characteristically found together with such herbs as *Galium kinuta*, *Artemisia keiskeana* and *Leontopodium japonicum*.

The following plants are the detected members of these limestone fields.

<b><i>Camptosorus sibiricus</i></b>	A	<i>Clematis stans</i>	B
<i>Dennstaedtia wilfordii</i>	B	<b><i>Berberis amurensis</i></b>	
<b><i>Gymnocarpium jessoense</i></b>	B	var. <b><i>japonica</i></b>	B
<i>Polystichum craspedosorum</i>	A	<i>Astilbe thunbergii</i>	B
<i>Larix leptolepis</i>	B	<i>Deutzia gracilis</i>	A
<i>Tsuga diversifolia</i>	B	<i>Kerria japonica</i>	B
<i>Buckleya lanceolata</i>	B	<i>Sorbus commixta</i>	B
<i>Dianthus barbatus</i>		<b><i>Spiraea nipponica</i></b>	B
var. <i>shinanensis</i>	A	<i>Lespedeza buergeri</i>	B
<i>Euptelea polyandra</i>	B	<i>Vicia deflexa</i>	B

Euonymus sieboldii	B	<b>Anaphalis sinica</b>	B
Acer mono	B	Artemisia keiskeana	B
Ligustrum tschonoskii	B	A. montana	B
Buddleja japonica	B	Leontopodium japonicum	B
Lonicera demissa	B	Saussurea triptera	B
Euphrasia maximowiczii	B	Solidgo virgaurea	
Galium kinuta	B	ssp. asiatica	B
Adenophora remotiflora	A		

### 17. Mt. Shiraiwa (Pref. Nagano)

About 10km southward of Mt. Kamanashi, there is another limestone mountain named Mt. Shiraiwa, 2267m in altitude. Its east side presents us an elusive limestone fields rich cliffs and rubbly slopes at the upper elevation, aproximately between 1900m and 2100m above sea level. Contrary to the dense forest of *Chamaecyparis obtusa* or the deciduous mixed woods covering major part of the mountain side, the vegetation on these limestone fields is much poor owing to driness of the habitats. Roughly speaking, the dry ridges are marked by scattered pine trees such as *Pinus koraiensis* and *P. pentaphylla* while the slopes are characterized by some crowded shrubs such as *Juniperus sargentii*, *Berberis amurensis* var. *japonica*, *Potentilla fruticosa* var. *mandshurica* and *Spiraea nipponica*. Crevices in cliffs, on the other hand, are favorable for many characteristic ferns or herbs. All these plants are as follows.

<b>Asplenium capillipes</b>	A	ssp. kamtschatica	B
A. <b>ruta-muraria</b>	A	Sedum aizoon	A
Dennstaedtia wilfordii	B	Astilbe thunbergii	B
<b>Gymnocarpium jessoense</b>	B	Deutzia gracilis	A
Polystichum craspedosorum	A	<b>Mitella nuda</b>	B
<b>Woodsia glabella</b>	A	(MIZUSHIMA 1959)	
W. polystichoides	A	Parnassia palustris	B
Larix leptolepis	B	Ribes maximowicziana	B
Pinus koraiensis	B	Aruncus dioicus	
P. pentaphylla	B	var. tenuifolius	
Tsuga diversifolia	B	<b>Potentilla fruticosa</b>	
Chamaecyparis obtusa	A B	var. <b>mandshurica</b>	A B
Juniperus rigida	B	<b>Spiraea nipponica</b>	A B
<b>J. sargentii</b>	A	Hedysarum ussuriensis	A
Thuja standishii	B	Geranium eriostemon	
Salix rupifraga	B	var. reinii	B
Boehmeria spicata	B	Celastrus orbiculatus	B
Actaea asiatica	B	Acer mono	B
Clematis stans	B	Rhamnus japonica	
Paeonia japonica	B	var. decipiens	B
Thalictrum minus		Tilia japonica	B
var. stipellatum	A B	Viola grypoceras	A B
<b>Berberis amurensis</b>		Daphne kamtschatica	
var. <b>japonica</b>	B	var. jezoensis	B
Epimedium grandiflorum		Bupleurum longiradiatum	
var. thunbergianum	B	f. elatius	A B
Arabis lyrata		Seseli ugoensis	B

<i>Tilingia tachiroei</i>	A	<i>A. montana</i>	B
<i>Rhododendron fauriei</i>		<i>Chrysanthemum makinoi</i>	A B
var. <i>roseum</i>	B	<i>Leontopodium japonicum</i>	A B
<i>Halenia corniculata</i>	B	<i>Saussurea triptera</i>	B
<i>Thymus serphyllum</i>		<i>Senecio takedanus</i>	B
ssp. <i>quinquecostatus</i>	B	<i>Solidago virgaurea</i>	
<i>Pedicularis keiskei</i>	B	ssp. <i>asiatica</i>	B
<i>Euphrasia matsumurae</i>	B	<i>Calamagrostis langsdorffii</i>	B
<i>Lonicera demissa</i>	B	<i>Melica onoei</i>	B
<i>Patrinia triloba</i>	B	<i>Lilium maximowiczii</i>	
<i>Scabiosa japonica</i>	B	f. <i>tenuifolium</i>	A
<b><i>Adenophora teramotoi</i></b>	A B	<i>Tofieldia coccinea</i>	
<i>Campanula punctata</i>		var. <i>kondoii</i>	A
<b><i>Anaphalis sinica</i></b>	A B	<i>Veratrum maackii</i>	
<i>Artemisia keiskeana</i>	B	var. <i>japonicum</i>	A

KOIZUMI (1926) noted the plants found on gravelly fields as well as on grass-land of the summit of this mountain. According to him, *Clematis alpina* var. *ochotensis*, *Heracleum lanatum* ssp. *moellendorffii*, *Linnaea borealis*, etc. may be added to the above.

#### 18. Todai (Pref. Nagano)

The two enormous cliffs called Makuiwa and Shiraiwa near Todai together with the other precipices adjacent to them are located between 1200m and 1800m above sea level, being purely constructed by limestone. As early as 1926 KOIZUMI paid his attention on a peculiar floristic aspect that they retained some plants of the frigid zone such as *Betula ermani*, *Tilingia tachiroei*, *Thymus serphyllum* ssp. *quinquecostatus*, *Pinguicula vulgaris*, *Adenophora nikoensis*, *Chrysanthemum rupestris*, *Ixeris dentata* ssp. *alpicola*, *Leontopodium japonicum* and *Veratrum longibracteatum*. Recently YAMAZAKI (1952) also investigated the flora of the present bluffs and emphasized that the western continental plants would tend to be differentiated here as exemplified by *Adenophora teramotoi*, *Euphrasia maximowiczii* var. *calcareae*, *Primula reinii* var. *brachycarpa* and *Leontopodium japonicum* var. *perniveum*, while the northern alpine plants retained here were not differentiated at all.

The following list of the plants might include all these facts.

<i>Asplenium capillipes</i>	A	<i>Laportea macrostachya</i>	B
<b>A. ruta-muraria</b>	A	<i>Buckleya lanceolata</i>	A
<b><i>Camptosorus sibiricus</i></b>	A	<i>Polygonum cuspidatum</i>	B
<i>Dennstaedtia wilfordii</i>	A B	<i>Euptelea polyandra</i>	A
<b><i>Gymnocarpium jessoense</i></b>	A	<i>Clematis stans</i>	A
<i>Polystichum craspedosorum</i>	A	<i>Thalictrum minus</i>	
<i>Selaginella tamariscina</i>	A	var. <i>stipellatum</i>	A
<b><i>Woodsia glabella</i></b>	A	Some are much dwarfened.	
<i>Pinus bicolor</i>	B	<b><i>Berberis amurensis</i></b>	
<i>Juniperus rigida</i>	B	var. <i>japonica</i>	A
<i>Salix rupifraga</i>	A	<i>Epimedium grandiflorum</i>	
<i>Carpinus japonica</i>	A	var. <i>thunbergianum</i>	B
<i>Boehmeria spicata</i>	A B	<i>Lindera obtusiloba</i>	B

Corydalis ochotensis		(TOYOKUNI and SATOMI 1957)	
var. raddeana	B	Cynanchum caudatum	B
Arabis lyrata		Thymus serpyllum	
ssp. kamtschatica	A	ssp. quinquecostatus	A
Orostachys erubescens	B	<b>Euphrasia maximowiczii</b>	
Sedum aizoon	A B	var. <b>calcarea</b>	B
Astilbe formosa	A	Melampyrum laxum	B
A. thunbergii	A	Pedicularis resupinata	A B
Deutzia gracilis	A	Pinguicula vulgaris	A
Parnassia alpicola	A	Galium kinuta	B
Philadelphus satsumi		Viburnum dilatatum	B
var. nikoensis	B	Scabiosa japonica	A B
Saxifraga fortunei		Campanula dasyantha	A
var. incisolobata	A	Adenophora divaricata	A
<b>Potentilla fruticosa</b>		A. <b>teramotoi</b>	A
var. <b>mandshurica</b>	A	<b>Anaphalis sinica</b>	
Prunus incisa	B	var. <b>pernivea</b> , var. nov.	A
Rosa luciae		var. <b>sinica</b>	A
var. hakonensis	B	Artemisia keiskeana	A B
<b>Spiraea nipponica</b>	A	A. montana	B
Astragalus membranaceus		Atractylodes japonica	B
var. obtusa	A	Chrysanthemum makinoi	A
Lespedeza buergeri	A B	C. rupestris	A B
Euphorbia sieboldiana	A B	Cirsium purpuratum	B
Rhus chinensis	A B	Ixeris dentata	
Euonymus alatus		ssp. alpicola	A
f. striatus	B	<b>Leontopodium japonicum</b>	
Berchemia pauciflora	B	var. japonicum	A B
<b>Rhamnus costata</b>	B	var. <b>perniveum</b>	A B
R. japonica		Senecio takedanus	B
var. decipiens	B	Solidago virgaurea	
Stachyurus praecox	B	ssp. asiatica	B
Daphne pseudomezereum	A	Youngia denticulata	B
Epilobium amurense	A	Miscanthus sinensis	A B
E. formosanum	B	Lilium maximowiczii	
Bupleurum longiradiatum		f. tenuifolium	A
f. elatius	A	Hosta longipes	A
Seseli ugoensis	B	<b>Smilax vaginata</b>	
Tilingia tachiroei	A	var. <b>stans</b>	A B
Helwingia japonica	B	Tofieldia coccinea	
Primula reinii		var. kondoii	A
var. brachycarpa	A	Veratrum maackii	
Fraxinus sieboldiana	B	var. japonicum	A
Halenia corniculata	A	Gymnadenia cucullata	A
<b>Gentiana contorta</b>	A		

#### 19. Mt. Jizodake (Pref. Nagano)

The same lode of limestone on which the previous three fields exist cuts the ridge from Mt. Senjo to Mt. Jizodake and presents us a rubbly corner at about 2300m in altitude. No tree was seen but *Spiraea nipponica* growing in crevices of rock. The following plants are members of this area.

Athyrium crenatum		Viola biflora	A
var. glabrum	C	Bupleurum longiradiatum	
Cryptogramma stelleri	A	f. elatius	B
Cystopteris fragilis	B	Heracleum lanatum	
<b>Gymnocarpium jessoense</b>	A B	var. moellendorffii	C
<b>Woodsia glabella</b>	A	Seseli ugoensis	B
Larix leptolepis	B	Nepeta subsessilis	B C
Salix rupifraga	B	Thymus serpyllum	
Aconitum deflexum	C	ssp. quinquecostatus	A
Thalictrum minus		Eritrichium nippoicum	B
var. hypoleucum	A	Veronicastrum sibiricum	
var. stipellatum	A	var. japonicum	B
Arabis lyrata		<b>Adenophora teramotoi</b>	A
ssp. kamtschatica	A	Anaphalis margaritacea	B C
Draba nipponica	A	Chrysanthemum rupestris	B C
Sedum aizoon		Leontopodium japonicum	A
ssp. kamtschaticum	A	Saussurea triptera	B C
Astilbe thunbergii	C	Senecio nemorensis	C
Parnassia palustris	A	Veratrum maackii	B C
<b>Spiraea nipponica</b>	A	var. japonicum	
Euphorbia sieboldiana	B		

## 20. Mt. Toyokuchi (Pref. Nagano)

Some huge limestone cliffs are found at the middle elevation, 1600m to 2200m in altitude, in this mountain. KOIZUMI (1926, 1952) pointed out that the alpine plants such as *Asplenium viride*, *Cryptogramma stelleri*, *Draba nipponica*, *Tilingia tachiroei* and *Pinguicula vulgaris* inhabited these cliffs, presenting one more 'relic frigid flora' in his own terminology. KUBOTA (1940 a b, 1952) also referred to the flora of these cliffs and enumerated the plants growing there. The following list of plants is partly dependent on their reports.

<b>Asplenium viride</b>	A	ssp. kamtschatica	A
Cryptogramma stelleri	A	Draba nipponica	A
Cystopteris fragilis	A	Some are glabrous (var. <i>linearis</i> ),	
<b>Lepisorus clathratus</b>	A	and the other densely pubescent.	
(KURATA 1956, as var. <i>namegatae</i> )		Sedum aizoon	A
Polystichum craspedosorum	A	Deutzia gracilis	A
<b>Woodsia glabella</b>	A	Philadelphus satsumi	
<b>Juniperus sargentii</b>	A	var. nikoensis	A
Salix rupifraga	A	Saxifraga fortunei	
Laportea bulbifera	B	var. incislobata	A
Dianthus barbatus		Potentilla dickinsii	A
var. shinanensis	B	<b>P. fruticosa</b>	
Melandryum keiskei	A	var. <b>mandshurica</b>	A
Aquilegia buergeriana	A	<b>Spiraea nipponica</b>	A
Cimicifuga acerina	A	Hedysarum ussuriense	A
<b>Berberis amurensis</b>		Geranium eriostemon	
var. <b>japonica</b>	A	var. reinii	A
Corydalis ochotensis		Euonymus planipes	A
var. raddeana	B	E. sieboldianus	
Arabis lyrata		var. sanguineus	A



Rhamnus japonica		Galium kinuta	A
var. decipiens	A	Lonicera demissa	A
Viola biflora	A	Patrinica triloba	
Bupleurum longiradiatum		var. palmata	A
f. elatius	A	<b>Adenophora teramotoi</b>	A
Tilingia tachiroei	A	Campanula punctata	
Enkianthus campanulatus	A	ssp. hondoensis	B
Menziesia pentandra	A	<b>Anaphalis sinica</b>	A
Primula reinii		Artemisia keiskeana	A
var. brachycarpa	A	Leontopodium japonicum	A
Ligustrum tschonoskii	A	Juncus maximowiczii	A
Halenia corniculata	A	Hosta longipes	A
Thymus serpyllum		Lilium maximowiczii	
ssp. quinquecostatus	A	f. tenuifolium	A
Pedicularis keiskei	A	Tofieldia coccinea	
Pinguicula vulgaris	A	var. kondoi	A

### 21. Upper Aoki-river (Pref. Nagano)

About 9km south of Oogawara in Ojika-mura there are two famous limestone bluffs called Tsubame-iwa and Tenshu-iwa. They are situated near the source of the Aoki-river and at about 1400m and 1600m above sea level respectively. KOIZUMI (1932, 1952) discussed on the alpine aspect of the flora of these bluffs, and regarded it also as 'relict frigid flora'. Owing to the situation overhanging the river, on their surface there occur humid vegetations with moss cover in some parts. The inhabitants of these two cliffs are as follows. Asterisked plants are quoted from Koizumi.

<b>Asplenium capillipes</b>	A	Epimedium grandiflorum	
<b>A. viride</b>	A	var. thunbergianum	B
Cystopteris fragilis	A	Draba nipponica	A
<b>Camptosorus sibiricus</b>	A	Both forms corresponding to var.	
Dennstaedtia wilfordii	A	<i>linearis</i> and var. <i>nipponica</i> .	
<b>Gymnocarpium jessoense</b>	A	Sedum aizoon	A
Polystichum craspedosorum	A	S. viride	A
<b>Woodsia glabella</b>	A	Astilbe thunbergii	
Chamaecyparis obtusa	B	var. congesta	B
* <b>Juniperus sargentii</b>	A	Deutzia gracilis	A
Salix rupifraga	A	Hydranges involucrata	B
Carpinus japonica	A	*Parnassia palustris	A
Boehmeria spicata	A B	Philadelphus satsumi	
Cercidiphyllum magnificum	B	var. nikoensis	B
Cimicifuga acerina		Ribes maximowiczianum	A
var. peltata	B	Rodgersia podophylla	B
C. simplex	B	Saxifraga cortusaefolia	A
Clematis stans	A	S. fortunei	
Paeonia obovata	B	var. incislobata	A
Thalictrum minus		*S. fusca	
var. stipellatum	A	ssp. kikubuki	A
<b>Berberis amurensis</b>		Aruncus dioicus	A
var. <b>bretschneideri</b>	A	var. tenuifolius	A

<b>*Potentilla fruticosa</b>		var. japonicum	B
var. <b>mandshurica</b>	A	<i>Galium pseudoasperellum</i>	B
<i>Spiraea chamaedrifolia</i>	A	<i>Aster ageratoides</i>	
<i>Euonymus alatus</i>		ssp. <i>leiophyllus</i>	B
f. <i>striatus</i>	A	<i>Lonicera demissa</i>	B
<b>Rhamnus costata</b>	B	* <i>Patrinia triloba</i>	
* <i>Viola biflora</i>	A	var. <i>palmata</i>	A
<i>Daphne pseudomezereum</i>	B	<b>Adenophora teramotoi</b>	
<i>Circaea alpina</i>	B	var. <i>hispidula</i> , var. nov.	A
<i>Epilobium amurense</i>	A	* <b>Anaphalis sinica</b>	A
<i>Angelica polymorpha</i>	A	<i>Cacalia delphiniifolia</i>	B
<i>Acanthopanax hypoleucus</i>	A	<i>Leontopodium japonicum</i>	A
<i>Bupleurum longiradiatum</i>		<i>Solidago virgaurea</i>	
f. <i>elatius</i>	A	ssp. <i>asiatica</i>	B
<i>Ostericum sieboldii</i>	B	<i>Calamagrostis arundinacea</i>	
* <i>Tilingia tachiroei</i>	A	var. <i>brachytricha</i>	A
<i>Menziesia multiflora</i>	B	C. <i>hakonensis</i>	A
<i>Rhododendron keiskei</i>	B	<i>Diarrhena japonica</i>	B
<i>Primula reinii</i>		<i>Juncus maximowiczii</i>	A
var. <i>brachycarpa</i>	A	<i>Hosta longipes</i>	A
<i>Fraxinus lanuginosa</i>		<i>Paris verticillata</i>	B
var. <i>serrata</i>	A	<i>Polygonatum maculatum</i>	A
<i>Ligustrum tschonoskii</i>	B	<b>Smilax vaginata</b>	
<i>Halenia corniculata</i>	A	var. <i>stans</i>	B
<i>Isodon umbrosus</i>	B	<i>Tofieldia coccinea</i>	
<i>Thymus serphyllum</i>		var. <i>kondoi</i>	A
ssp. <i>quinquecostatus</i>	A	<i>Tricyrtis latifolia</i>	A
<i>Veronicastrum sibiricum</i>			

## 22. Mt. Ishimaki (Pref. Aichi)

Mt. Ishimaki (400m), situated at about 8km eastnortheast of Toyohashi, was appointed to be a Natural Monument in 1952 for its peculiar limestone flora including *Camptosorus sibiricus*, *Sedum verticillatum*, *Eriobotrya japonica*, *Spiraea nipponica*, *Ponciris trifoliata*, *Zanthoxylum planispinum*, *Euonymus dorsicostatus*, *Hibiscus syriacus*, *Aucuba japonica*, *Diospyros lotus*, *Dammacanthus indicus* and *Lonicera gracilipes* var. *glandulosa* (cf. a Guide Sign). The summit of this mountain is occupied by limestone blocks, where *Clematis stans*, *Spiraea nipponica* and *Zabelia integrifolia* are found characteristically. On the mountain sides a little down the top, there appear gravelly slopes with *Philadelphus satsumi*, *Orixa japonica*, *Ligustrum obtusifolium* and *Alangium platanifolium* var. *trilobum* abundant, and huge cliffs inhabited by *Camptosorus sibiricus*, *Polystichum craspedosorum*, *Debregaesia edulis*, *Mercurialis leiocarpa*, etc.

Basing upon a note of TORII (1956) and my observation, the following plants were detected from these limestone fields.

<i>Asplenium pekinense</i>	A	var. <i>tosae</i>	A
A. <i>sarelii</i>	A	<i>Cyrtomium falcatum</i>	A
A. <i>varians</i>	A	<i>Gonocormus minutus</i>	A
<b>Camptosorus sibiricus</b>	A	<i>Polystichum craspedosorum</i>	A
<i>Crepidomanes makinoi</i>		P. <i>tsussimense</i>	A

<i>Pyrrosia linearifolia</i>	A	<i>Desmodium racemosum</i>	B
<i>Torreya nucifera</i>	B	<i>Citrus tachibana</i>	A
<i>Boehmeria spicata</i>	B	<i>Orixa japonica</i>	B
<i>Debregaesia edulis</i>	A	<i>Ponciris trifoliata</i>	B
<i>Pilea japonica</i>	A	<i>Mercurialis leiocarpa</i>	A
<i>P. mongolica</i>	A	<i>Euonymus fortunei</i>	
<i>Ficus erecta</i>	A B	var. <i>radicans</i>	B
<i>Stellaria sessiliflora</i>	A	<i>Actinidia arguta</i>	B
<i>Clematis stans</i>	A	<i>Hibiscus syriacus</i>	B
<i>Sinomenium acutum</i>	B	<i>Alangium platanifolium</i>	
<i>Lindera glauca</i>	B	var. <i>trilobum</i>	B
<i>Cardamine impatiens</i>	A	<i>Ligustrum obtusifolium</i>	B
<i>Wasabia tenuis</i>	A	<i>Gardneria nutans</i>	B
<i>Sedum aizoon</i>		<i>Clerodendron trichotomum</i>	B
var. <i>kamtschaticum</i>	A	<i>Agastache rugosa</i>	A B
<i>S. verticillatum</i>	A	<b><i>Zabelia integrifolia</i></b>	A
<i>Philadelphus satsumi</i>	B	<i>Miscanthus sinensis</i>	B
<i>Ribes fasciculatum</i>	B	Hispid on leaves beneath.	
<i>Pourthiaea villosa</i>		<i>Carex brunnea</i>	B
var. <i>laevis</i>	B	<i>Smilax sarumame</i>	B
<b><i>Spiraea nipponica</i></b>	B		

The same paper of TORII (1956) refers to the limestone flora of the Honsakapass, 3km north east of Mt. Ishimaki, and also to Magoshi, 3km north of it. In the former, it is characterized by the *Prunus zippeliana*-community accompanying *Asplenium wrightii*, *Neocheiropteris ensata*, *Pteris inaequalis* var. *aequata*, *Cornus macrophylla* and *Scrophularia kakudensis*. In the latter the limestone ridge is characteristically inhabited by the following plants.

<i>Torreya nucifera</i>	<i>Zanthoxylum piperitum</i>
<i>Cephalotaxus harringtonia</i>	Z. <i>planispinum</i>
<i>Ficus erecta</i>	Z. <i>schinifolium</i>
<i>Sinomenium acutum</i>	<i>Mercurialis leiocarpa</i>
<i>Cardamine impatiens</i>	<i>Securinega suffruticosa</i>
<i>Kerria japonica</i>	<i>Euonymus alatus</i>
<i>Orixa japonica</i>	<i>Berchemia racemosa</i>
<i>Ponciris trifoliata</i>	<i>Acanthopanax japonicus</i>

### 23. Shinshiro (Pref. Aichi)

A small area known as the Sakurabuchi park stands on the limestone district in the suburbs of Shinshiro-cho about 20km north of Toyohashi. *Quercus glauca* together with *Celtis sinensis* var. *japonica* and *Zelkova serrata* represents the sparse forest around there. Those and the lower woods or shrubs under them, mainly from limestone rubbly places, are listed below.

<i>Asplenium pekinense</i>	A	<i>Lygodium japonicum</i>	A
<b><i>Camptosorus sibiricus</i></b>	A	<i>Onychium japonicum</i>	A
<i>Cyrtomium fortunei</i>	A	<i>Polystichopsis aristata</i>	A
<i>Dryopteris lacera</i>	A	<i>Polystichum craspedosorum</i>	A
<i>Gonocormus minutus</i>	A	<i>Pteris cretica</i>	A
<i>Lemmaphyllum microphyllum</i>	A	<i>Pyrrosia lingua</i>	A

Selaginella involvens	A	Wisteria floribunda	B
Vittaria flexuosa	A	Orixa japonica	B
Quercus glauca	B	Zanthoxylum planispinum	B
Celtis sinensis		Celastrus orbiculatus	A
var. japonica	B	Parthenocissus tricuspidatus	A
Zelkova serrata	B	Camellia japonica	B
Morus bombycis	B	Aucuba japonica	B
Ficus erecta	B	Helwingia japonica	B
F. nipponica	A	Ligustrum obtusifolium	B
Berberis thunbergii	B	Osmanthus ilicifolium	B
Nandina domestica	B	Trachelospermum asiaticum	B
Menispermum dauricum	A	Callicarpa japonica	B
Machilus japonica	B	Aster ageratoides	
Neolitsea sericea	B	ssp. leiophyllus	A
Deutzia gracilis	A	Calamagrostis arundinacea	
Kerria japonica	B	var. brachytricha	A
Pourthiaea villosa		Carex brunnea	
var. laevis	B	var. nakiri	B
Rubus buergeri	A	Hosta sp.	A
Lespedeza bicolor		Dioscorea tokoro	B
f. acutifolia	B		

#### 24. Mt. Kurohime (Pref. Niigata)

In the westernmost part of Pref. Niigata, there occur the limestone formations known as Omi-limestone and Myojo-limestone, presenting Mt. Kurohime (1221.5m elev.) and Mt. Myojo (1188.5m elev.) respectively. Both the mountains resemble with regard to their physiognomy. The higher parts are represented by rocky and gravelly scree, while the middle and lower ones are in some parts provided with enormous vertical precipices and in other parts with mild slopes without exposed limestone.

In Mt. Kurohime, the vegetation on the limestone scree around the summit is represented in the shrub layer by *Thuja standishii* (even in crevices of limestone), *Spiraea nipponica* and the shrub-like oaks, maples and lindens which do not extend to 2m high and in the herb layer by *Galium verum* var. *asiaticum* f. *nikkoense*, *Melica nutans* and *Miscanthus sinensis*. From the cliff at the foot of this mountain near Shimizukura, *Phyllitis scoropendrium*, *Boehmeria spicata*, *Saxifraga fortunei* var. *incislobata* and *Youngia denticulata* are frequent. The collected plants in these fields are as below.

Adiantum pedatum	A	Boehmeria spicata	A
<b>Asplenium ruta-muraria</b>	A	B.    tricuspis	A
Dennstaedtia wilfordii	A	Thalictrum minus	
Phyllitis scoropendrium	A	var. hypoleucum	A
Polystichum craspedosorum	A	Epimedium glandiflorum	
<b>Juniperus sargentii</b>	A	var. thunbergianum	B
(an information from a villager)		Astilbe thunbergii	
Thuja standishii	A B	var. congesta	A

Philadelphus satsumi	A	var. oblongifolia	B
Saxifraga fortunei		Rhododendron trinerve	A
var. incisolobata	A	Tripetaleia paniculata	
Sorbus alnifolius	B	var. latifolia	B
<b>Spiraea nipponica</b>	B	Vaccinium smalli	
<b>Buxus microphylla</b>		var. glabrum	B
var. japonica	A	Galium kinuta	B
Ilex sugeroki		Patrinia triloba	A
ssp. longipedunculata	B	Eupatrium glehni	B
Euonymus oxyphyllus	B	Solidago virgaurea	
Acer mono	B	ssp. asiatica	A B
Tilia japonica	B	Youngia denticulata	A
Alangium platanifolium		Melica nutans	A B
var. trilobum	B	Miscanthus sinensis	A B
Leucothoe grayana		Hosta longipes	A

### 25. Mt. Myojo (Pref. Niigata)

The limestone vegetation of this mountain is approximately the same with Mt. Kurohime. The gravelly scree around the summit is also characterized by *Thuja standishii*, *Acer mono* and *Tilia japonica*. Around the southern foot, *Cephalotaxus harringtonia* ssp. *nana*, *Berberis amurensis* var. *japonica*, *Zanthoxylum piperitum*, *Rhamnus japonica* var. *decipiens*, etc. and *Juniperus sargentii*, *Buxus microphylla* var. *japonica*, *Hypericum kamtschaticum* var. *senanense*, *Artemisia keiskeanda*, etc. are often and characteristically found on rubbly slopes and extended walls of limestone, respectively. The list of the plants from these fields are as below.

Adiantum pedatum	A	var. brevipedicellata	A
<b>Asplenium ruta-muraria</b>	A	C. stans	A B
Athyrium okuboanum	B	Paeonia japonica	B
<b>Camptosorus sibiricus</b>	A	Thalictrum minus	
Cyrtomium fortunei	B	var. hypoleucum	A
Dennstaedtia wilfordii	A	<b>Berberis amurensis</b>	
Dryopteris uniformis	B	var. japonica	B
Phyllitis scoropendrium	A	Epimedium grandiflorum	
Polystichum tsussimense	A	var. thunbergianum	B
Pteris cretica	A	Magnolia salicifolia	B
Torreya nucifera	B	Lindera umbellata	B
Cephalotaxus harringtonia		Sedum aizoon	
ssp. nana	B	ssp. kamtschaticum	A
Pinus pentaphylla	B	Deutzia gracilis	A
Cryptomeria japonica	B	Philadelphus satsumi	A
<b>Juniperus sargentii</b>	A	Saxifraga fortunei	
Thuja standishii	A B	var. incisolobata	A
Carpinus japonica	B	Hamamelis japonica	B
Quercus serrata	B	Rubus palmatus	
Boehmeria tricuspis	A	var. coptophyllus	B
Laportea bulbifera	B	Sorbus alnifolia	B
Clematis japonica		S. commixta	B

<i>Spiraea nipponica</i>	A	<i>Chelonopsis moschata</i>	B
<i>Zanthoxylum piperitum</i>	A B	<i>Isodon inflexus</i>	A
<i>Euphorbia pekinensis</i>		<i>Thymus serpyllum</i>	
var. <i>japonensis</i>	A	ssp. <i>quinquecostatus</i>	A
<b><i>Buxus microphylla</i></b>		<i>Pedicularis resupinata</i>	B
var. <b><i>japonica</i></b>	A	<i>Phtheirospermum japonicum</i>	B
<i>Ilex sugerokii</i>		<i>Veronicastrum sibiricum</i>	
ssp. <i>longipedunculata</i>	B	var. <i>japonicum</i>	A
<i>Euonymus alatus</i>		<i>Galium verum</i>	
f. <i>striatus</i>	B	vra. <i>asiaticum</i>	
<i>Acer mono</i>	B	f. <i>nikoense</i>	A
<i>A. sieboldianum</i>	B	? <i>Lonicera ramosissima</i>	B
<i>Berchemia longeracemosa</i>	B	<i>Abelia spathulata</i>	A
<i>Rhamnus japonica</i>		<i>Viburnum furcatum</i>	B
var. <i>decipiens</i>	A	<i>Patrinia triloba</i>	A
<i>Tilia japonica</i>	B	<i>Scabiosa japonica</i>	F
<i>Camellia japonica</i>		<i>Adenophora triphylla</i>	
?ssp. <i>rusticana</i>	B	sap. <i>aperticampanulata</i>	A
<i>Hypericum kamtschaticum</i>		<i>Artemisia keiskeana</i>	A
var. <i>senanense</i>	A	<i>Chrysanthemum makinoi</i>	A
<i>Viola gryoceras</i>	A	<i>Aster ageratooides</i>	
<i>Stachyurus praecox</i>	B	ssp. <i>leiophyllus</i>	A
<i>Hedera rhombea</i>	A	<i>Leibnitzia anandria</i>	B
<i>Bupleurum longiradiatum</i>		<i>Solidago virgaurea</i>	
f. <i>elatus</i>	A B	var. <i>asiatica</i>	B
<i>Seseli ugoensis</i>	A	<i>Youngia denticulata</i>	B
<i>Helwingia japonica</i>	B	<i>Arundinella hirsuta</i>	A B
<i>Leucothoe grayana</i>		<i>Miscanthus sinensis</i>	B
var. <i>oblongifolia</i>	B	<i>Hosta longipes</i>	A
<i>Rhododendron trinerve</i>	B	<i>Polygonatum lasianthum</i>	B
<i>Tripetaleia paniculata</i>		<i>Smilax sieboldii</i>	A
var. <i>latifolia</i>	B	<b>S. <i>vaginata</i></b>	
<i>Fraxinus lanuginosa</i>		var. <b><i>stans</i></b>	A B
var. <i>serrata</i>	B	<i>Veratrum maackii</i>	
<i>Ligustrum tschonoskii</i>	B	var. <i>japonicum</i>	
<i>Clerodendron trichotomum</i>	A	<i>Dioscorea tokoro</i>	A
<i>Agastache rugosa</i>	B		

## 26. Kanetsuri (Pref. Toyama)

Some outcrops of limestone are found here and there, though in small scale, around the upper district of the Kurobe valley in Pref. Toyama. A vertical precipice of crystalline limestone near Kanetsuri, for example, is characterized by *Asplenium ruta-muraria*, *Dennstaedtia wilfordii*, *Polystichum craspedosorum*, *Clematis stans* and *Bupleurum longiradiatum* f. *elatus*. At the foot of this cliff, where appears a rocky and gravelly slope, *Laportea macrostachya*, *Rhus ambigua*, *Acer mono* and *Alangium plataniifolium* var. *trilobum* are growing predominantly.

All the detected plants are as below.

<i>Asplenium ruta-muraria</i>	A	<i>Acer mono</i>	B
<i>Cyrtomium fortunei</i>	A	<i>Aesculus turbinata</i>	B
<i>Dennstaedtia wilfordii</i>	A	<i>Hypericum kamtschaticum</i>	
<i>Polystichum craspedosorum</i>	A	var. <i>senanense</i>	A
<i>P. tripteris</i>	B	<i>Viola grypoceras</i>	A
<i>Carpinus cordata</i>	B	<i>Bupleurum longiradiatum</i>	
<i>Zelkova serrata</i>	B	f. <i>elatus</i>	A
<i>Boehmeria nivea</i>		<i>Aralia elata</i>	B
ssp. <i>nipononivea</i>	B	<i>Fraxinus</i> sp.	B
<i>B. spicata</i>	A B	<i>Comanthosphaea stellipila</i>	B
<i>Laportea macrostachya</i>	B	<i>Galium verum</i>	
<i>Clematis stans</i>	A	var. <i>asiaticum</i>	
<i>Thalictrum minus</i>		f. <i>nikkoense</i>	A
var. <i>stipellatum</i>	A	<i>Lonicera</i> sp.	A
<i>Deutzia gracilis</i>	A	<i>Artemisia keiskeana</i>	A
<i>Philadelphus satsumi</i>	A B	<i>A. montana</i>	B
<i>Schizophragma hydrangeoides</i>	A	<i>Aster ageratoides</i>	
<i>Potentilla dickinsii</i>	A	ssp. <i>leiophyllus</i>	A
<i>Zanthoxylum piperitum</i>	B	<i>Chrysanthemum makinoi</i>	A
<i>Euonymus fortunei</i>		<i>Miscanthus sinensis</i>	A B
var. <i>radicans</i>	A	<i>Hosta longipes</i>	A
<i>Rhus ambigua</i>	B	<i>Lilium maximowiczii</i>	A

### 27. Kanagasaki (Pref. Fukui)

At Kanagasaki of Tsuruga at the bottom of the Tsuruga bay, there is a limestone district along the coast about 1.5km wide. The vegetation is represented by the waste-land plants such as *Polygonum cuspidatum*, *Mallotus japonicus*, *Rhus chinensis* and *Miscanthus sinensis* as well as the maritime ones such as *Sedum oryzifolium*, *Lysimachia mauritiana* and *Setaria viridis* var. *pachystachys*. The characteristic plants of limestone were not recognizable. The plants detected are as below.

<i>Cyrtomium falcatum</i>	A	<i>Spiraea blumei</i>	A
<i>Celtis sinensis</i>		<i>Albizia julibrissin</i>	B
var. <i>japonica</i>	B	<i>Caesalpinia japonica</i>	B
<i>Zelkova serrata</i>	B	<i>Indigofera pseudotinctoria</i>	A
Dwarf and with thickened leaves.		<i>Pueraria lobata</i>	A
<i>Polygonum cuspidatum</i>	A B	<i>Mallotus japonicus</i>	A B
<i>Dianthus superbus</i>		<i>Euonymus alatus</i>	B
var. <i>longicalycinus</i>	A	<i>Ampelopsis brevipedunculata</i>	B
<i>Clematis terniflora</i>	A	<i>Vitis thunbergii</i>	A
<i>Thalictrum minus</i>		<i>Elaeagnus macrophylla</i>	B
var. <i>hypoleucum</i>	A	<i>Hedera rhombea</i>	A
<i>Cocculus trilobus</i>	A	<i>Cornus macrophylla</i>	B
<i>Arabis stelleri</i>		<i>Trachelospermum asiaticum</i>	A
var. <i>japonica</i>	A	<i>Lysimachia mauritiana</i>	B
<i>Sedum oryzifolium</i>	A	<i>Ligustrum obtusifolium</i>	B
<i>Pittosporum tobira</i>	B	<i>Solanum nigrum</i>	A
<i>Rosa multiflora</i>	B	<i>Paederia scandens</i>	

var. maritima	A	<i>Youngia denticulata</i>	A
<i>Artemisia montana</i>	A	<i>Agropyron tsukushiense</i>	
<i>Aster ageratoides</i>		var. <i>transiens</i>	A
ssp. <i>amplexifolius</i>	A	<i>Miscanthus sinensis</i>	A B
<i>Bidens biternata</i>	A	<i>Setaria viridis</i>	
<i>Chrysanthemum makinoi</i>		var. <i>pachystachys</i>	A
?var. <i>wakasaense</i>	A	<i>Liriope platyphylla</i>	A
<i>Erigeron canadensis</i>	A		

### 28. Tone (Pref. Fukui)

There is an old limestone quarry at about 400m above sea level, 10km southeast of Tsuruga. The limestone hill, which was covered by red soils to some extent, was cut to present us some gravelly fields here and there. The vegetation is very poor on such places, being represented by only waste-land plants. There could be found no characteristic plants of limestone, too.

<i>Pteridium aquilium</i>		<i>Teucrium japonicum</i>	B
var. <i>japonicum</i>	B	<i>Paederia scandens</i>	
<i>Polygonum cuspidatum</i>	B	var. <i>mairei</i>	B
<i>Duchesnea indica</i>		<i>Artemisia montana</i>	B
var. <i>leucocephala</i>		A. <i>princeps</i>	B
f. <i>japonica</i>	B	<i>Erigeron canadensis</i>	B
<i>Desmodium racemosum</i>	B	<i>Kalimeris yomena</i>	B
<i>Pueraria lobata</i>	B	<i>Petasites japonicus</i>	B
<i>Geranium thunbergii</i>	B	<i>Sonchus oleraceus</i>	B
<i>Mallotus japonicus</i>	B	<i>Youngia denticulata</i>	B
<i>Rhus chinensis</i>	B	<i>Commelina communis</i>	B
<i>Ampelopsis brevipedunculata</i>	B	<i>Miscanthus sinensis</i>	B
<i>Seseli ugoensis</i>	B	<i>Setaria viridis</i>	B
<i>Torilis japonica</i>	B		

### 29. Matsuodera (Pref. Kyoto)

There appears a small limestone district around Matsuodera, east of Maizuru. Rounded rocks of limestone are scattered on the ground and red soils fill the space between them. Here a dense forest with *Machilus thunbergii* and *Neolitsea sericea* dominant stands over this district. Its subordinate members are all included in the following list.

<i>Athyrium niponicum</i>	B	<i>Ficus nipponica</i>	A
<i>Leptogramma mollissima</i>	B	<i>Morus bombycis</i>	B
<i>Lemmaphyllum microphyllum</i>	A	<i>Akebia trifoliata</i>	B
<i>Microlepia marginata</i>	A	<i>Cocculus trilobus</i>	B
<i>Onychium japonicum</i>	A	<i>Neolitsea sericea</i>	B
<i>Torreya nucifera</i>	B	<i>Schisandra nigra</i>	B
<i>Cephalotaxus harringtonia</i>		<i>Deutzia crenata</i>	B
ssp. <i>nana</i>	B	<i>Philadelphus satsumi</i>	B
<i>Carpinus tchonoskii</i>	B	<i>Pourthiaea villosa</i>	
<i>Castanea crenata</i>	B	var. <i>laevis</i>	B



<i>Rosa multiflora</i>	B	<i>Actinidia argentea</i>	B
<i>Rubus parvifolius</i>	B	<i>Stachyurus praecox</i>	B
<i>Caesalpinia japonica</i>	B	<i>Hedera rhombea</i>	A
<i>Pueraria lobata</i>	B	<i>Aucuba japonica</i>	B
<i>Wisteria brachybotrys</i>	B	<i>Cornus macrophylla</i>	B
<i>Zanthoxylum schinifolium</i>	B	<i>Styrax japonica</i>	B
<i>Picrasma quassioides</i>	B	<i>Tracherospermum asiaticum</i>	B
<i>Mallotus japonicus</i>	B	<i>Viburnum erosum</i>	B
<i>Rhus chinensis</i>	B	<i>Artemisia keiskeana</i>	B
<i>Euonymus japonicus</i>		<i>Miscanthus sinensis</i>	B
var. <i>radicans</i>	B	<i>Liriope platyphylla</i>	B
<i>Acer mono</i>	B	<i>Smilax china</i>	B
<i>Aesculus turbinata</i>	B	<i>Dioscorea quinqueloba</i>	B
<i>Vitis coignetiae</i>	B		

### 30. Mt. Ibuki (Pref. Shiga)

Mt. Ibuki (1377m elev.) is botanically well known for the historical and phytogeographical importance. It was an old medicinal plant garden controlled by Nobunaga ODA as long ago as 380 years. Thus some European herbs such as *Lathyrus pratensis* and *Vicia sepium* are naturalized from this old cultivation. Phytogeographically, it is often the limit of the area of some northern or southern species. For example, *Barbalea orthoceras*, *Spiraea nipponica* and *Viola acuminata* are the members the southern limits of which are represented by Mt. Ibuki, while *Arabis flagellosa* and *Spiraea nervosa* are those which never distribute more northwards than this mountain. *Cerastium furcatum* var. *ibukiensis* and *Cirsium confertissimum* are examples of the endemic forms.

Geologically Mt. Ibuki is mainly constructed by the limestone formation. Limestone is exposed everywhere on the upper half. So far as the west side is concerned, the lower side is covered with deep red soils caused by advanced leaching of  $\text{CaCO}_3$  and other components. At the lower elevation of the east side, on the other hand, limestone is replaced by sandstone. Here I could some data to compare the vegetations on calcareous stands with those on silicious ones (SHIMIZU 1959 a).

Ecologically the arborous vegetation is hardly seen on the west slope as well as on the summit area because of human activity, except the small woods of *Cryptomeria* and of *Quercus* at the foot. On the east and lower side, the deciduous mixed forest of *Carpinus*, *Quercus* and *Acer* develops continuously from foot to more than 1000m in altitude.

The following list includes the selected plants only from limestone habitats but neither from red soils on the west slope nor from siliceous stands on the east side.

<i>Asplenium ruta-muraria</i>	A	<i>Carpinus cordata</i>	B
<i>Camptosorus sibiricus</i>	A	<i>japonica</i>	B
<i>Leptogramma mollissima</i>	B	<i>laxiflora</i>	B
<i>Chloranthus serratus</i>	B	<i>Corylus sieboldiana</i>	B

<i>Quercus mongolica</i>		<i>Euonymus alatus</i>	
var. <i>grosseserrata</i>	B	f. <i>striatus</i>	A
<i>Boehmeria spicata</i>	A B	<i>E. oxyphyllus</i>	B
<i>Aconitum crassipes</i>	A B C	<i>E. sieboldiana</i>	A B
Form with glabrous peduncles.		<i>Staphylea bumalda</i>	B
<i>Cimicifuga simplex</i>	B	<i>Acer palmatum</i>	
<i>C. acerina</i>		ssp. <i>matsumurae</i>	B
var. <i>peltata</i>	B	<i>A. mono</i>	B
<i>Hepatica nobilis</i>		<i>A. rufinerve</i>	B
var. <i>japonica</i>	B	<i>Rhamnus japonica</i>	
<i>Ranunculus japonicus</i>	A	var. <i>microphylla</i>	B
<i>Akebia quinata</i>	B	<i>Ampelopsis brevipedunculata</i>	B
<i>Epimedium sempervirens</i>	B	<i>Viola grypoceras</i>	B
<i>Lindera obtusiloba</i>	B	<i>V. hondoensis</i>	B
<i>Parabenzoin praecox</i>	B	<i>Angelica decursiva</i>	B
<i>P. trilobum</i>	B	<i>Heracleum lanatum</i>	C
<i>Barbarea orthoceras</i>	B C	<i>Tilingia kousa</i>	B
<b><i>Sisymbrium luteum</i></b>	B C	<i>Cornus controversa</i>	B
<i>Sedum subtile</i>	A	<i>C. holopetala</i>	B
<i>S. verticillatum</i>	A	<i>Helwingia japonica</i>	B
<i>Deutzia gracilis</i>	A	<i>Fraxinus spaethiana</i>	B
Some with purplish and small		<i>Ligustrum obtusifolium</i>	B
flowers 6-7mm in corolla length.		<i>L. tschonoskii</i>	A
<i>Philadelphus satsumi</i>	A B	<i>Syringa reticulata</i>	B
<i>Schizophragma hydrangeoides</i>	B	<i>Cynanchum ascrifolium</i>	B
<i>Chaenomeles japonica</i>	B	<i>C. sublanceolatum</i>	
<i>Filipendula multijuga</i>	C	var. <i>obtusulum</i>	B
<i>Kerria japonica</i>	B	<i>Isodon japonicus</i>	B
<i>Potentilla chinensis</i>	B	<i>Lamium album</i>	
<i>Pourthiaea villosa</i>		var. <i>barbatum</i>	B
var. <i>laevis</i>	B	<i>Thymus serpyllum</i>	
<i>Rosa multiflora</i>	B	ssp. <i>quinquecostatus</i>	B
<i>Sorbus alnifolia</i>	B	<b><i>Euphrasia inumai</i></b>	B
<i>Spiraea japonica</i>		<i>Veronicastrum sibiricum</i>	
var. <i>alpina</i>		var. <i>japonicum</i>	A B
f. <i>ibukiensis</i>	A	Corresponding to var. <i>humile</i> NAKAL.	
<i>S. nervosa</i>	A	<i>Galium kinuta</i>	B
<i>S. nipponica</i>	A	<i>G. verum</i>	
<i>Stephanandra incisa</i>	B	var. <i>asiaticum</i>	
<i>Desmodium racemosum</i>	B	f. <i>nikkoense</i>	B
<i>Dumasia truncata</i>	B	<i>Rubia chinensis</i>	
<i>Indigofera pseudotinctoria</i>	B	var. <i>glabrescens</i>	B
<i>Wisteria brachybotrys</i>	B	<i>Abelia spathulata</i>	B
<b><i>Geranium robertianum</i></b>	A B	<i>Viburnum dilatatum</i>	B
<i>Orixa japonica</i>	B	<i>V. erosum</i>	B
<i>Zanthoxylum piperitum</i>	B	<b><i>Zabelia integrifolia</i></b>	A B
<i>Euphorbia pekinensis</i>		<i>Artemisia japonica</i>	B
var. <i>japonensis</i>	B	<i>Aster ageratoides</i>	
<i>Ilex crenata</i>	B	ssp. <i>leiophyllus</i>	B
<i>Celastrus orbiculatus</i>	B	<b><i>Chrysanthemum makinoi</i></b>	A B

		Tetraploid race (SHIMIZU 1962).		Disporum smilacinum	B
Cirsium confertifissimum	B C			Hosta montana	B C
Serratula coronata				Ophiopogon planiscapus	B
ssp. insularis	B			Veratrum maackii	
Solidago virgaurea				f. macranthum	B
ssp. asiatica	B C			var. japonicum	B
Carex sp.	B			Dioscorea nipponica	B
Allium thunbergii	B			D. tokoro	B

### 31. Mt. Ryozen (Pref. Shiga)

Mt. Ryozen (1084m elev.) is the nearest southern peak of the previous mountain and the northernmost member of the Suzuka mountains. Similarly, limestone is exposed around the summit where there develops the elusive undulating grassland and soils are mostly reddish. The middle and lower side are occupied by the deciduous woods or the planted forest of *Cryptomeria* under which limestone is hardly found. The following plants are concerned with limestone crevices and rubbly lands near the summit in particular.

Asplenium incisum	A	Pourthiaea villosa	
A. <b>ruta-muraria</b>	A	var. laevis	B
<b>Camptosorus sibiricus</b>	A	<b>Geranium robertianum</b>	B
Cyrtomium fortunei	A	Euphorbia sieboidiana	A
Leptogramma mollissima	B	Rhus ambigua	B
Phyllitis scoropendrium	A	Ilex crenata	B
Polystichum tripterum	B	Euonymus alatus	
Cephalotaxus harringtonia		f. striatus	A
ssp. nana	B	E. sieboldianus	B
Carpinus japonica	B	Staphylea bumalda	B
Laportea macrostachya	B	Viola grypoceras	A
Polygonum cuspidatum	A	Daphne pseudomezereum	B
Aconitum sp.	B	Alangium platanifolium	
Cimicifuga simplex	B	var. trilobum	B
Clematis stans	A	Heracleum lanatum	B
Hepatica nobilis		Cornus macrophylla	B
var. japonica	B	Rhododendron japonicum	B
Ranunculus japonicus	B	R. kaempferi	B
Akebia quinata	B	Symplocos chinensis	
Arabis gemmifera	B	var. leucocarpa	
Wasabia japonica	A	f. pilosa	B
Cool place near a limestone cave.		Ligustrum obtusifolium	B
Astilbe thunbergii	B	Comanthosphace stellipila	B
Deutzia gracilis	A	Viburnum dilatatum	A
Philadelphus satsumi	B	<b>Chrysanthemum makinoi</b>	A B
Saxifraga cortusaeifolia	B	Tetraploid race (SHIMIZU 1962).	
Agrimonia pilosa	B	Taraxacum sp.	B
Chaenomeles japonica	B	Melica nutans	B
Potentilla freyniana	B	Carex sp.	B
		Allium sp.	B

## 32. Gongen-dani (Pref. Shiga)

At the southern foot of Mt. Ryozen there is a narrow valley named Gongendani about 200m or so in altitude. Cliffs or rubbly slopes of limestone, alternating with those of siliceous rock, fall into this river on both sides. Although no dense forest is generally seen, some colonies of *Sinomenium acutum*, *Geranium robertianum* and *Rhus ambigua* are very characteristic of the sunny rubbly limestone slopes, whereas *Philadelphus satsumi* and *Spiraea nervosa* are the important species inhabiting limestone crevices as well as on rubbly slopes. These plants could not be found on siliceous stands around there. Some comparisons of the floristic components on them with those on limestone there will be referred in PART III. Anyway the plants detected from limestone fields in the present district are as below.

<i>Asplenium sarelii</i>	A	leaves beneath and the other	
<i>Athyrium okuboanum</i>	B	almost glabrous.	
<b>Camptosorus sibiricus</b>	A	<i>Saxifraga fortunei</i>	
<i>Cyrtomium fortunei</i>	A	var. <i>incisolobata</i>	A
<i>Dennstaedtia wilfordii</i>	A	<i>Kerria japonica</i>	B
<i>Lemmaphyllum microphyllum</i>	A	<i>Rubus phoenicorasius</i>	B
<i>Phyllitis scoropendrium</i>	A	<b><i>Spiraea nervosa</i></b>	A
<i>Polystichum craspedosorum</i>	A	<i>Lespedeza buergeri</i>	A
<i>P. tsussimense</i>	A	<b><i>Geranium robertianum</i></b>	B
<i>Pteris multifida</i>	A	<i>Orixa japonica</i>	A
<i>Cephalotaxus harringtonia</i>		<i>Euphorbia sieboldiana</i>	A
ssp. <i>nana</i>	B	<i>Mercurialis leiocarpa</i>	B
<i>Zelkova serrata</i>	B	<i>Rhus ambigua</i>	B
<i>Elatostemma umbellatum</i>		<i>Euonymus alatus</i>	
var. <i>majus</i>	A	f. <i>striatus</i>	A
<i>Buckleya lanceolata</i>	B	<i>E. oxyphyllus</i>	B
<i>Polygonum cuspidatum</i>	A	<i>Meliosma tenuis</i>	A
<i>Euptelea polyandra</i>	A B	<i>Parthenocissus tricuspidatus</i>	B
<i>Anemone hupehensis</i>		<i>Vitis coignetiae</i>	B
var. <i>japonica</i>	A B	<i>Actinidia polygama</i>	B
<i>Clematis stans</i>	B	<i>Viola grypoceras</i>	A
<i>Thalictrum minus</i>		<i>Fraxinus lanuginosa</i>	
var. <i>hypoleucum</i>	A	var. <i>serrata</i>	A
<i>Akebia quinata</i>	B	<i>Syringa reticulata</i>	B
<i>Sinomenium acutum</i>	B	<i>Trigonotis brevipes</i>	A
<i>Neolitsea sericea</i>	B	<i>Veronica melissaefolia</i>	A
<i>Arabis flagellosa</i>	A	<i>Lonicera</i> sp.	B
<i>Cardamine leucantha</i>	A B	<i>Ixeris stolonifera</i>	B
<i>Sedum subtile</i>	A	<i>Youngia denticulata</i>	A
<i>S. verticillatum</i>	A	<i>Y. japonica</i>	A
<i>Astilbe thunbergii</i>	B	<i>Calamagrostis arundinacea</i>	
<i>Deutzia crenata</i>	A	var. <i>brachytricha</i>	A
<i>D. gracilis</i>	A	<i>Festuca parvigluma</i>	A
<i>Hydrangea serrata</i>	A	<i>Poa sphondylodes</i>	A
<i>Philadelphus satsumi</i>	A	<i>Carex curvicolis</i>	A
Some are sparsely pubescent on		<i>Allium tuberosum</i>	A

*Chionographis japonica* A      *Hosta longipes* A

### 33. Mt. Fujiwara (Pref. Mie)

Mt. Fujiwara (1100m elev.) is also a member of the Suzuka mountain range. As the whole the lower and middle part is covered by deep red soils though we often come across rocks and rubbly lands of limestone. In its upper part there develops a broad grassland like in Mt. Ibuki and in Mt. Ryozen, contrary to the deciduous woods on the lower part. The plants detected from cliffs, gravelly bush lands and gravelly grasslands are as below.

<i>Adiantum pedatum</i>	B	<i>Neolitsea sericea</i>	B
<i>Asplenium sarelii</i>	A	<i>Parabenzoin praecox</i>	B
<i>Athyrium mesosorum</i>	B	<i>Chelidonium japonicum</i>	B
<b><i>Camptosorus sibiricus</i></b>	A	<i>Arabis flagellosa</i>	A
<i>Cyrtomium fortunei</i>	B	<i>A. gemmifera</i>	A
<i>Davallia mariesii</i>	A	<i>Sedum verticillatum</i>	B
<i>Dennstaedtia wilfordii</i>	A	<i>Chrysosplenium grayanum</i>	B
<i>Dryopteris uniformis</i>	B	<i>Deutzia crenata</i>	A
<i>Lemmaphyllum microphyllum</i>	A	<i>D. gracilis</i>	A
<i>Neochieiropteris ensata</i>	A	<i>D. maximowicziana</i>	A
<i>Onychium japonicum</i>	A	<i>Hydrangea serrata</i>	B
<i>Phyllitis scoropendrium</i>	A	<i>Mitella leiopetala</i>	B
<i>Polystichum craspedosorum</i>	A	<i>Philadelphus satsumi</i>	A B
<i>P. tsussimense</i>	A	<i>Saxifraga fortunei</i>	
<i>Pteris multifida</i>	A	<i>var. incisolobata</i>	A
<i>Torreya nucifera</i>	B	<i>Kerria japonica</i>	A B
<i>Carpinus japonica</i>	B	<i>Pourthiaea villosa</i>	
<i>Corylus sieboldiana</i>	C	<i>var. laevis</i>	A
<i>Zelkova serrata</i>	B	<i>Rosa multiflora</i>	B
<i>Ficus nipponica</i>	A	<i>Rubus buergeri</i>	A
<i>Boehmeria spicata</i>	A	<i>R. microphylla</i>	B
<i>B. tricuspis</i>	A	<i>R. palmatus</i>	B
<i>Asarum caulescens</i>	B	<b><i>Spiraea nervosa</i></b>	A
<i>A. sieboldii</i>	B	<i>Stephanandra incisa</i>	A
<i>Polygonum cuspidatum</i>	A	<i>Caesalpinia japonica</i>	A B
<i>Stellaria uchiyamana</i>		<i>Indigofera pseudotinctoria</i>	A
<i>f. apetala</i>	B	<i>Lespedeza buergerii</i>	A
<i>Aconitum grossedentatum</i>	B	<i>Oxalis acetocella</i>	
<i>A. loczyanum</i>	B	<i>ssp. griffithii</i>	B
<i>Adonis amurensis</i>	B	<b><i>Geranium robertianum</i></b>	A
<i>Anemone flaccida</i>	B	<i>Orixa japonica</i>	A B
<i>A. nikoensis</i>	B	<i>Zanthoxylum piperitum</i>	B
<i>A. pseudoaltaica</i>	B	<i>Mallotus japonicus</i>	B
<i>Clematis stans</i>	A B	<i>Mercurialis leiocarpa</i>	A
<i>Thalictrum actaeifolium</i>	A B	<i>Securinega suffruticosa</i>	A
<i>Akebia quinata</i>	B	<b><i>Buxus microphylla</i></b>	
<i>Berberis thunbergii</i>	B	<i>var. japonica</i>	A
<i>Epimedium sp.</i>	B	<i>Rhus ambigua</i>	B
<i>Nandina domestica</i>	B	<i>Euonymus alatus</i>	

f. alatus	B	Pedicularis resupinata	B
f. striatus	B	Galium kinuta	B
Staphylea bumalda	B	Abelia spathulata	B
Acer carpiniifolius	B	Viburnum dilatatum	B
A. mono	B	<b>Zabelia integrifolia</b>	B
Berchemia racemosa	B	Campanula punctata	B
Rhamnus japonica		Ainsliaea apiculata	A
var. microphylla		Aster ageratoides	
Stachyurus praecox	A	ssp. leiophyllus	A
Daphne pseudomezereum	B	Chrysanthemum makinoi	A B
Alangium platanifolium		Cirsium suzukaense	B
var. trilobum	A	Erigeron annuus	A
Aucuba japonica	B	Youngia denticulata	A
Helwingia japonica	B	Miscanthus sinensis	B
Fraxinus lanuginosa		Poa tubifera	B
var. serrata	B	Erythronium japonicum	B
Ligustrum obtusifolium	B	Fritillaria muraiana	B
Trachelospermum asiaticum	A	Ophiopogon japonicus	B
Lamium album		Trillium smallii	B
var. barbatum	B	Tulipa latifolia	B

### 34. Foot of Mt. Nonobori (Pref. Mie)

Westnorthwest of Kameyama and around the eastern foot of Mt. Nonobori, limestone occurs here and there along a branch of the Suzuka-river. Some singular spectacles such as Shakudaijin and Byôbuiwa owe limestone bluffs thanks. Although surface of these cliffs is hardly covered by vegetation, there appear comparatively dense bushes on rubbly lands near the cliffs. *Torreya nucifera*, *Boehmeria spicata*, *Neolitsea sericea*, *Kerria japonica*, *Orixa japonica*, *Phyllanthus flexuosus*, *Alangium platanifolium* var. *trilobum* and *Aucuba japonica* are their important members. All these detected plants are included in the following list.

Athyrium unifurcatum	A	Arabis flagellosa	A
<b>Camptosorus sibiricus</b>	A	Deutzia gracilis	A
Cyrtomium fortunei	B	D. maximowicziana	A
Dryopteris lacera	A	Philadelphus satsumi	B
Polystichum craspedosorum	A	Schizophragma hydrangeoides	B
Pteris cretica	B	Kerria japonica	B
P. multifida	A	Rosa wichuraiana	B
Torreya nucifera	A B	Rubus crataegifolius	A
Cephalotaxus harringtonia	C	R. phoenicorasius	B
Zelkova serrata	B	<b>Spiraea nervosa</b>	A
Boehmeria spicata	B	Stephanandra incisa	A
Urtica thunbergiana	B	Lespedeza buergeri	B
Euptelea polyandra	A	Leaflets smaller than 2.7cm × 1.3cm.	
Clematis stans	A	Wisteria brachybotrys	A
Akebia quinata	B	Orixa japonica	B
Sinomenium acutum	B	Zanthoxylum schinifolium	B
Neolitsea sericea	B	Picrasma quassioides	A

Mallotus japonicus	A	Ligustrum japonicum	A B
Phyllanthus flexuosus	B	L. obtusifolium	B
Sapium japonicum	A	Osmanthus ilicifolius	A
Euonymus alatus		Trachelospermum asiaticum	B
f. alatus	A B	Marsdenia tomentosa	B
f. striatus	A	Callicarpa mollis	A
E. fortunei		Abelia spathulata	B
var. radicans	A	A. tetrasepala	A
Acer carpinifolium	B	Viburnum dilatatum	A
A. palmatum	B	Aster ageratoides	
Ampelopsis brevipedunculata	A	ssp. leiophyllus	A
Parthenocissus tricuspidatus	A	Eupatrium chineusis	
Camellia japonica	B	var. simplicifolium	B
Eurya japonica	B	Syneilesis palmata	A B
Viola grypoceras	A	Youngia denticulata	A
Stachyurus praecox	B	Miscanthus sinensis	A B
Daphne pseudomezereum	B	Lilium maximowiczii	
Elaeagnus pungens	B	f. tenuifolium	B
Alangium platanifolium		Ophiopogon japonicus	B
var. trilobum	B	O. ohwii.	B
Hedera rhombea	A	Polygonatum maculatum	A
Aucuba japonica	B	Smilax nipponica	B
Helwingia japonica	A B	Dioscorea japonica	B
Rhododendron kaempferi	B		

### 35. Shiraya (Pref. Nara)

In the upper district of the Yoshino river, limestone is often exposed and presents many a great cliff in the vicinity of Shiraya and Kashiwagi in particular. In this and the next article, the floras of these two cliff regions, Shiraya and Kashiwagi, will be described separately.

Regarding the former region, about 300m in altitude, though I did not yet visit there, KOSHIMIZU (1954) published a short sketch of the flora in which he attached importance to presence of *Eriobotrya japonica* in wild state. The other plants recorded by him as found on limestone are all included in the following list.

Adiantum monochlamys	A	Selaginella involvens	A
Asplenium incisum	A	Woodsia manchuriensis	A
A. prolongatum	A	Brousonettia kazinoki	A
<b>Camptosorus sibiricus</b>	A	Ficus nipponica	A
Cyrtomium fortunei	A	Boehmeria spicata	A
Lemmaphyllum microphyllum	A	Euptelea polyandra	A
Lepisorus thunbergianus	A	Arabis flagellosa	A
Loxogramme saziran	A	Sedum makinoi	A
Neocheiropteris ensata	A	S. verticillatum	A
Polypodium niponicum	A	Deutzia scabra	A
Polystichum tsussimense	A	<b>Eriobotrya japonica</b>	A
Pteris multifida	A	Spiraea blumei	A
Pyrosia linearifolia	A	Mercurialis leiocarpa	A

<i>Impatiens hypophylla</i>	A	<i>Cornus controversa</i>	A
<i>Alangium platanifolium</i>		<i>Syringa reticulata</i>	A
var. <i>trilobum</i>	A	<i>Anodendron affine</i>	A
<i>Angelica shikokiana</i>	A	<i>Lonicera</i> sp.	A

### 36. Kashiwagi (Pref. Nara)

Kashiwagi is about 6km southeast of the previous field. It is in this district where there are two great limestone caves named Fudo-kutsu and Tennin-kutsu, which are derived from the enormous bluffs overhanging the river.

TERAO (1960) studied the vegetation of these cliffs and of the neighbourhood, and outlined as follows.

On sunny cliffs, *Asplenium ruta-muraria*, *Juniperus sargentii*, *Spiraea nervosa* (correctly *S. blumei*), *Lespedeza buergeri*, *Diplomorpha sikokiana* and *Fraxinus lanuginosa* var. *serrata* are most frequent. On shady cliffs, *Phyllitis scoropendrium*, *Polystichum craspedosorum*, *Saxifraga fortunei* var. *incisolobata*, *Orixa japonica*, *Berchemia racemosa*, *Alangium platanifolium* var. *trilobum*, *Helwingia japonica* and *Tricyrtis hirta* are growing abundantly. At sunny gravelly ridges *Zabelia integrifolia*-*Spiraea nervosa* (correctly *S. blumei*) community, on sunny screes colonies of *Asplenium ruta-muraria*, on humid gravelly slopes *Orixa japonica*-*Helwingia japonica* community, on sunny slope gravelly but to some extent covered with soils the light forest of *Berchemia berchemiaefolia* and on mossy gravelly lands *Camptosorus sibiricus* community are characteristic, respectively.

The list of the detectable plants in this region is as below.

<i>Adiantum monochlamys</i>	A	<b><i>Juniperus sargentii</i></b>	A
<b><i>Asplenium ruta-muraria</i></b>	A	<i>Quercus glauca</i>	B
A. <i>sarelii</i>	A	Q. <i>salicina</i>	B
<b><i>Camptosorus sibiricus</i></b>	A	<i>Boehmeria spicata</i>	A
<i>Cyrtomium fortunei</i>	A	<i>Euptelea polyandra</i>	B
C. <b><i>caryotideum</i></b>	A	<i>Clematis apiifolia</i>	B
(TERAO 1960)		<i>Thalictrum minus</i>	
<i>Dryopteris lacera</i>	A	var. <i>hypoleucum</i>	A
<i>Lemmaphyllum microphyllum</i>	A	<i>Akebia trifoliata</i>	B
<i>Phyllitis scoropendrium</i>	A	<i>Nandina domestica</i>	B
<i>Polystichum craspedosorum</i>	A	<i>Lindera obtusiloba</i>	A
P. <i>tsussimense</i>	A	<i>Arabis flagellosa</i>	A
<i>Pteris cretica</i>	A	<i>Sedum makinoi</i>	A
P. <i>multifida</i>	A	<i>Deutzia gracilis</i>	A
P. <b><i>yamatensis</i></b>	A	<i>Philadelphus satsumi</i>	B
(TAGAWA 1935, as <i>P. angustipinna</i>		<i>Saxifraga fortunei</i>	
var. <i>yamatensis</i> )		var. <i>incisolobata</i>	A
<i>Pyrrosia linearifolia</i>	A	<i>Schizophragma hydrangeoides</i>	A
<i>Selaginella tamariscina</i>	A	<b><i>Eriobotrya japonica</i></b>	A
<i>Vittaria flexuosa</i>	A	<i>Kerria japonica</i>	A
<i>Torreya nucifera</i>	B	<i>Rosa multiflora</i>	B
<i>Cephalotaxus harringtonia</i>	B	<i>Spiraea blumei</i>	A



<i>Lespedeza buergeri</i>	A	<i>Alangium platanifolium</i>	
<i>Orixa japonica</i>	B	var. <i>trilobum</i>	B
<i>Zanthoxylum planispinum</i>	B	<i>Hedera rhombea</i>	A
Z. <i>schinifolium</i>	B	<i>Aucuba japonica</i>	B
<i>Phyllanthus flexuosus</i>	B	<i>Cornus macrophylla</i>	A
<i>Securinega suffruticosa</i>	B	<i>Helwingia japonica</i>	B
<b><i>Buxus microphylla</i></b>		<i>Fraxinus lanuginosa</i>	
var. <b><i>japonica</i></b>	A	var. <i>serrata</i>	A
<i>Ilex pedunculosa</i>	B	<i>Trachelospermum asiaticum</i>	B
<i>Euonymus alatus</i>		<i>Marsdenia tomentosa</i>	B
f. <i>striatus</i>	B	<i>Conandron ramondioides</i>	A
E. <i>fortunei</i>		<i>Galium kinuta</i>	A
var. <i>radicans</i>	A	<i>Abelia spathulata</i>	B
<i>Meliosma myriantha</i>	B	<b><i>Zabelia integrifolia</i></b>	A
<i>Berchemia berchemiaefolia</i>	B	<i>Chrysanthemum indicum</i>	A
B. <i>racemosa</i>	B	C. <i>makinoi</i>	A
<i>Rhamnus japonica</i>		<i>Syneilesis palmata</i>	A
var. <i>microphylla</i>		<i>Ophiopogon japonicus</i>	B
<i>Parthenocissus tricuspidatus</i>	A	<i>Tricyrtis hirta</i>	A
<i>Diplomorpha sikokiana</i>	B		

### 37. Mts. Oomine (Pref. Nara)

In the way from Mt. Gyojagaeri to Mt. Misen both in Mts. Oomine, we can find a belt of the limestone area of about 200m in width acrossing the ridge (1500m elev.). Rounded rocks of limestone are more or less densely scattered throughout this area, and black soils fill up between them. As reported in my previous paper (SHIMIZU 1959 b), the vegetaion is markedly contrasted between this and the adjacent non-calcareous area. Roughly speaking, it is represented by the mixed forest of beech and maple on both the areas. But, in the shrub and herb layer the floristic components and their abundance are greatly changed between them. For example, the shrub layer is much inconspicuous on the non-calcareous field, while *Philadelphus sastumi* var. *nikoensis*, *Rhamnus costata*, *Syringa reticulata*, etc. are well growing on the calcareous one. Such comparison of the vegetaion between these different fields will be mentioned in detail later (PART III). Here only a plant list from the present calcareous field is proposed.

<b><i>Dryopteris monticola</i></b>	C	<i>Urtica laetevirens</i>	C
D. <i>polylepis</i>	C	<i>Polygonum nepalense</i>	C
<i>Leptogramma mollissima</i>	C	<i>Aconitum grossedentatum</i>	C
<i>Abies homolepis</i>	C	<b><i>Anemonopsis macrophylla</i></b>	C
<i>Pterocarya rhoifolia</i>	C	<i>Cimicifuga simplex</i>	C
<i>Carpinus japonica</i>	C	<i>Clematis obovallata</i>	C
<i>Corylus sieboldiana</i>	C	<i>Paeonia obovata</i>	C
<i>Fagus crenata</i>	C	<i>Berberis tschonoskyana</i>	B
<i>Laportea bulbifera</i>	C	<b><i>Sisymbrium luteum</i></b>	C
<i>Pilea japonica</i>	C	<i>Sedum sordidum</i>	A
P. <i>hamaoi</i>	C	On mossy limestone.	

Chrysosplenium echinus	C	Fraxinus lanuginosa	
Deutzia floribunda	B	var. serrata	B
Kirengeshoma palmata	C	Ligustrum tchonokii	B
Philadelphus satsumi		Syringa reticulata	B
var. nikoensis	B	Cynanchum asarifolium	C
Schizophragma hydrangeoides	B	C. caudatum	C
Agrimonia pilosa	C	Chelonopsis moschata	C
Geum japonicum	C	Clinopodium chinense	
Potentilla centigramma	C	ssp. grandiflorum	
Pourthiaea villosa		var. shibetchense	C
var. laevis	B	C. multicaule	C
Rubus minusculus	C	Lamium ambiguum	C
Sorbus commixta	C	Scrophularia duplicato-serrata	B
Spiraea blumei	A	Veronica melissaefolia	C
Stephanandra incisa	B	Plantago asiatica	C
Picrasma quassioides	A	Galium kinuta	B C
Geranium tripartitum	C	G. paradoxum	A
Euonymus alatus		On mossy limestone.	
f. striatus	B	G. trifloriforme	C
E. oxyphyllus	B	Abelia spathulata	B
E. sieboldianus		Sambucus racemosa	
var. sanguineus	C	ssp. sieboldiana	B
Staphylea bumalda	B	Viburnum furcatum	C
Acer japonicum	C	V. wrightii	C
Impatiens noli-tangere	C	Peracarpa carnosa	
<b>Rhamnus costata</b>	B	var. circaeoides	C
R. japonica		Aster ageratoides	
var. microphylla	B	ssp. leiophyllus	C
Actinidia arguta	C	Cirsium gyojanum	C
Daphne pseudomezereum	B	Ligularia fischerii	C
Elaeagnus montana	B	Saussurea nipponica	C
Circaea alpina	C	Brachypodium sylvaticum	C
C. erubescens	C	Diarrhena japonica	C
Panax japonicus	C	Milium effusum	C
Angelica decursiva	C	Carex foliosissima	C
Heracleum lanatum	C	Arisaema sp.	C
Spuriopimpinella nikoensis	C	Hosta montana	C
Cornus kousa	B	Lilium medeoloides	C
Helwingia japonica	B	Veratrum maackii	C
Symplocos coreana	C		

### 38. Yura (Pref. Wakayama)

At and near the sea coast in Yura-cho of Wakayama pref. there occur limestone formations. I could collect the following plants on a limestone hill en route from Ena to Oobiki in this district. Most of them are also found in the adjoining siliceous fields and are common in the coastal districts as south as the present one. But, two of them, viz. *Clematis williamsii* and *Eriobotrya japonica*, are confined to the calcareous hillsides, while *Zanthoxylum planispinum*, *Mercurialis leiocarpa* and *Marsdenia tomentosa* seem to be biased

to the limestone habitats.

Asplenium sarelii	A	Cinnamomum japonicum	B
Cyrtomium falcatum	A	Machilus japonica	B
Microlepidia strigosa	B	<b>Eriobotrya japonica</b>	A
Podocarpus macrophylla	B	Prunus zippeliana	B
Piper kadzura	A	Zanthoxylum planispinum	B
Ficus erecta	A	Mercurialis leiocarpa	B
F. nipponica	A	Elaeagnus pungens	B
F. wightiana	A	Xylosma japonica	B
Debregeasia edulis	B	Bupleurum falcatum	B
Aquilegia adoxoides	A	Gardeneria nutans	B
<b>Clematis williamsii</b>	B	Marsdenia tomentosa	B
With small flowers ca. 2cm in diameter.		Senecio scandens	B

### 39. Katsuyama (Pref. Okayama)

There is a well-known water-fall named Kanbanotaki, 500m alt., about 4km north of Katsuyama, Maniwa-gun. Although the substratum of the water-fall and its very adjacent area is not of calcareous rock, the hillside which is some hundred meters forward the water-fall, is constructed by the Permian carboniferous limestone. Unfortunately the vegetation of the hill has been partly destroyed for facilities of excursion to the water-fall. Depending on my observation, however, the floristic members of this calcareous field and non-calcareous one are still of striking contrast. As far as the limestone slope is concerned, the vegetation is represented by the mixed forest comprising of *Torreya nucifera*, *Castanopsis cuspidata*, *Zelkova serrata*, *Neolitsea sericea*, *Acer carpinifolium*, *A. palmatum* and *Hovenia dulcis*, *Euptelea polyandra*, *Philadelphus satsumi* var. *nikoensis*, *Phyllanthus flexuosus*, *Rhus ambigua*, *Hosiea japonica*, *Rammella franguloides* and *Alangium plataniifolium* are striking shrubs or climbers being absent from the siliceous fields around there. The detected plants are as below.

Asplenium sarelii	A	Clematis tosaensis	A
? <b>Cyrtomium caryotideum</b>	B	Thalictrum actaeifolium	A
C. falcatum	B	Cocculus trilobus	B
Phyllitis scoropendrium	B	Sinomenium acutum	B
Torreya nucifera	B	Lindera umbellata	B
Castanopsis cuspidata		Neolitsea sericea	B
var. sieboldii	B	Arabis flagellosa	A
Zelkova serrata	B	Cardamine leucantha	B
Morus tiliaefolia	B	Sedum bulbiferum	B
Boehmeria nivea		S. verticillatum	A
ssp. nipponivea	A B	Deutzia gracilis	A
Laportea macrostachya	B	Philadelphus satsumi	
Pilea japonica	A	var. nikoensis	B
P. petiolaris		Schizophragma hydrangeoides	B
ssp. pseudopetiolaris	B	Kerria japonica	B
Euptelea polyandra	B	Rosa sambucina	A

<b>Spiraea nervosa</b>		<i>Stachyurus praecox</i>	B
var. <b>latifolia</b>	A	<i>Ampelopsis brevipedunculata</i>	B
<i>Wisteria brachybotrys</i>	B	<i>Alangium platanifolium</i>	
<i>Orixa japonica</i>	B	var. <i>trilobum</i>	B
<i>Zanthoxylum piperitum</i>	B	<i>Circaea cordata</i>	B
<i>Acer carpinifolium</i>	B	<i>Hedera rhombea</i>	A
<i>A. cissifolium</i>	B	<i>Spuriopimpinella calycina</i>	B
<i>A. palmatum</i>	B	<i>Aucuba japonica</i>	B
<i>Euonymus fortunei</i>		<i>Cornus controversa</i>	B
var. <i>radicans</i>	B	<i>Diospyros lotus</i>	B
<i>Hosiea japonica</i>	B	<i>Ligustrum obtusifolium</i>	B
<i>Hovenia dulcis</i>	B	<i>Ajuga japonica</i>	B
<i>Rhamnella franguloides</i>	B	<i>Galium pogonanthum</i>	A
<b>Buxus microphylla</b>		<i>Gymnaster savatieri</i>	B
var. <b>japonica</b>	B	<i>Brachypodium sylvaticum</i>	A
<i>Rhus ambigua</i>	B	<i>Arisaema ringens</i>	B
<i>Mallotus japonicus</i>	B	<i>Pinellia tripartita</i>	A
<i>Mercurialis leiocarpa</i>	B	<i>Dioscorea tokoro</i>	B
<i>Phyllanthus flexuosus</i>	B		

#### 40. Niimi (Pref. Okayama)

The district known as the Atetsu-daichi, which formerly belonged to Atetsu-gun and in present to Niimi-shi, is one of the most famous limestone districts in Japan. Although majority of the district is covered with deep red soils to be an elusive plateau, in some parts limestone is exposed and there occur, on one hand, some delimited limestone fields here and there such as the so-called Fudonotaki, Makiana and Rashomon, and, on the other hand, an enormous cliff region called Atetsu-kyo derived from the Takahashi river penetrating the present plateau.

In this article, I intend to describe the floras of Rashomon which is a depressed limestone area with closed or shady vegetation, of Fudonotaki which is a huge cliff with rather dry vegetation, and of the Atetsu-kyo which occupies the long distance more than 12km between Ikura and Shoden, separately.

The limestone vegetation of Ikura and Rashomon was recently announced by TERA0 (1955), so that the analytical vegetational aspect of these fields should be referred to him. Here I will offer only the floristic materials available to my own hand.

(1) Rashomon——This is a well delimited depressed area surrounded by high walls of limestone. They exhibit in some parts mossy humid vegetation with *Asplenium capillipes*, *Polystichum craspedosorum*, *Elatostemma umbellatum* var. *majus*, *Saxifraga cortusaeifolia* and so on, and in other parts scattered shady vegetation with *Camptosorus sibiricus*, *Polystichum tsussimense*, *Arabis flagellosa*, *Aster ageratoides* ssp. *leiophyllus* and so on but without moss covers. On the gravelly ground, *Cephalotaxus harringtonia*, *Hosiea japonica*, *Acer carpinifolium*, *Rhamnella franguloides* and *Aucuba japonica* are conspicuously abundant. On sunny gravelly places upward the limestone walls, there is

recognized, as TERAO (1955) pointed out, a sparse forest with *Pinus densiflora* and *Quercus variabilis* dominant. The detected plants are as below.

<b>Asplenium capillipes</b>	A	<i>Cardiandra alternifolia</i>	A
A. <b>ruta-muraria</b>	A	<i>Deinathe bifida</i>	B
A. <b>sarelii</b>	A	<i>Deutzia gracilis</i>	A
<i>Athyrium okubobanum</i>	A B	<i>Hydrangea luteovenosa</i>	B
A. <b>pichnosorum</b>	B	H. <b>serrata</b>	A B
A. <b>unifurcatum</b>	A B	<i>Mitella pauciflora</i>	B
<b>Camptosorus sibiricus</b>	A	<i>Philadelphus satsumi</i>	
<i>Cyrtomium fortunei</i>		var. <b>nikoensis</b>	A
var. <b>clivicolum</b>	A	<i>Saxifraga cortusaefolia</i>	A
var. <b>fortunei</b>	B	S. <b>fusca</b>	
<b>Hypodematium glanduloso-pilosum</b>	A	ssp. <b>kikubuki</b>	A
<i>Lemmaphyllum microphyllum</i>	A	<i>Kerria japonica</i>	B
<i>Polystichum craspedosorum</i>	A	<i>Stephanandra incisa</i>	A
P. <b>rigens</b>	B	<i>Indigofera pseudotinctoria</i>	B
P. <b>tsussimense</b>	A B	<i>Wisteria brachybotrys</i>	B
<i>Pteris cretica</i>	A	<i>Orixa japonica</i>	B
<i>Pyrrosia linearifolia</i>	A	<i>Zanthoxylum planispinum</i>	B
<i>Selaginella tamariscina</i>	A	<i>Picrasma quassioides</i>	A
<i>Cephalotaxus harringtonia</i>	B	<i>Mercurialis leiocarpa</i>	B
<i>Pinus densiflora</i>	B	<i>Phyllanthus flexuosa</i>	B
<i>Juniperus rigida</i>	B	<b>Buxus microphylla</b>	
<i>Carpinus laxiflora</i>	A B	var. <b>japonica</b>	B
<i>Quercus glauca</i>	B	<i>Ilex pedunculosa</i>	B
Q. <b>variabilis</b>	B	<i>Euonymus alatus</i>	
<i>Brousonettia kazinoki</i>	B	f. <b>striatus</b>	B
<i>Morus tiliaefolia</i>	B	<i>Staphylea bumalda</i>	B
<i>Boehmeria spicata</i>	B	<i>Hosiea japonica</i>	B
<i>Elatostemma laetevirens</i>	A	<i>Acer carpinifolium</i>	B
E. <b>umbellatum</b>		<i>Rhamnella franguloides</i>	B
var. <b>majus</b>	A	<i>Rhamus japonica</i>	
<i>Pilea mongolica</i>	A	var. <b>microphylla</b>	A
P. <b>petiolaris</b>		<i>Stachyurus praecox</i>	B
ssp. <b>pseudopetiolaris</b>	B	<i>Elaeagnus pungens</i>	B
<i>Urtica thunbergianum</i>	B	<i>Aucuba japonica</i>	B
<i>Polygonum filiforme</i>	B	<i>Helwingia japonica</i>	B
<i>Achyranthes japonica</i>	B	<i>Ligustrum obtusifolium</i>	B
<i>Clematis stans</i>	A	<i>Gardeneria multiflora</i>	A
<i>Akebia trifoliata</i>	B	<i>Trachelospermum asiaticum</i>	B
<i>Menispermum dauricum</i>	B	<i>Tylophora aristrochioides</i>	A
<i>Lindera obtusiloba</i>	B	<i>Meehania urticifolia</i>	B
L. <b>umbellata</b>	B	<i>Conandron ramondioides</i>	A
<i>Neolitsea sericea</i>	B	<i>Abelia spathulata</i>	B
<i>Chelidonium majus</i>		A. <b>tetrsepala</b>	B
ssp. <b>asiaticum</b>	B	<b>Viburnum carlesii</b>	
<i>Arabis flagellosa</i>	A	var. <b>bitchiuense</b>	B
<i>Sedum makinoi</i>	A	V. <b>dilatatum</b>	B
S. <b>verticillatum</b>	A	V. <b>erosum</b>	B

V. plicatum		C. makinoi	B
var. tomentosum	B	Lactuca raddeana	
<b>Zabelia integrifolia</b>	A	var. elata	B
Valeriana flaccidissima	A	<b>Youngia yoshinoi</b>	A
Artemisia keiskeana	B	Asperella longearistata	A
Aster ageratoides		Calamagrostis arundinacea	
ssp. leiophyllus	A	var. brachytrichia	A
Chrysanthemum indicum	B	Ophiopogon japonicus	A

(2) Tanagase—The so-called Fudônotaki at Tanagase is a small but high waterfall which comes down on the surface of a great exposed limestone bluff. The delimited area surrounding this waterfall shows us a characteristic limestone vegetation. The cliff itself is inhabited by *Camptosorus sibiricus*, *Hypodematium glanduloso-pilosum*, *Deutzia gracilis*, *Eriobotrya japonica*, *Spiraea nervosa* var. *latifolia*, *Buxus microphylla* var. *japonica*, *Gardeneria multiflora*, *Viburnum carlesii* var. *bitchuense*, *Artemisia keiskeana* and *Youngia yoshinoi*. On rubbly steep slope down the cliff there well grow *Torreya nucifera*, *Quercus glauca*, *Nandina domestica*, *Neolitsea sericea*, *Kerria japonica*, *Orixa japonica*, *Zanthoxylum planispinum* and *Alangium platanifolium* var. *trilobum*.

All the components on this cliff and slope are shown as below.

Aleuritopteris argentea	A	ssp. pseudopetiolaris	B
<b>Asplenium ruta-muraria</b>	A	Thalictrum actaeifolium	A B
A. sarelii	A	T. minus	
Athyrium okuboanum	B	var. stipellatum	A
A. unifurcatum	B	Epimedium sp.	A
<b>Camptosorus sibiricus</b>	A	Nandina domestica	B
Cyrtomium fortunei	A B	Menispermum dauricum	A
<b>Hypodematium glanduloso-pilosum</b>	A	Neolitsea sericea	B
Lemmaphyllum microphyllum	A	Sedum makinoi	A
Polystichum craspedosorum	A	Deutzia gracilis	A
P. tsussimense	A B	Hydrangea serrata	A B
Pteris cretica	A B	Philadelphus satsumi	A
P. multifida	A	<b>Eriobotrya japonica</b>	A B
Pyrrosia linearifolia	A	Kerria japonica	A B
Selaginella tamariscina	A	Rosa sp.	A
Torreya nucifera	B	Rubus buergeri	B
Juniperus chinensis	A	<b>Spiraea nervosa</b>	
Quercus glauca	B	var. <b>latifolia</b>	A
Q. salicina	B	Wisteria brachybotrys	B
<b>Carpinus turezhanovii</b>	B	Orixa japonica	B
Zelkova serrata	A	Zanthoxylum planispinum	B
Brousonettia kazinoki	A	Acalypha australis	A
Morus tiliaefolia	A	Mercurialis leiocarpa	B
Ficus nipponica	A	Securinega suffruticosa	A
Boehmeria nivea		<b>Buxus microphylla</b>	
ssp. nipponivea	A B	var. <b>japonica</b>	A
B. spicata	A	Rhus chinensis	A
Elatostema laetevirens	A	Euonymus fortunei	
Pilea petiolaris		var. radicans	B

<i>E. oxyphyllus</i>	B	var. <i>trichopetalum</i>	A
<i>Acer nikoensis</i>	B	<i>Paederia scandens</i>	
<b><i>Rhamnus yoshinoi</i></b>	A	var. <i>mairei</i>	B
<i>Parthenicissus tricuspidatus</i>	A	<b><i>Viburnum carlesii</i></b>	
<i>Viola grypoceras</i>	A	var. <i>bitchiuense</i>	A
<i>V. sp.</i>	A	<i>V. erosum</i>	B
<i>Edgeworthia papyrifera</i>	B	<b><i>Zabelia integrifolia</i></b>	A
<i>Elaeagnus pungens</i>	B	<i>Gynostemma pentaphyllum</i>	B
<i>Alangium platanifolium</i>		<i>Artemisia keiskeana</i>	A
var. <i>trilobum</i>	B	<i>Carpesium abrotanoides</i>	B
<i>Hedera rhombea</i>	A	<i>Chrysanthemum indicum</i>	A
<i>Spuriopimpinella calycina</i>	A	<i>Pertya glabrescens</i>	B
<i>Aucuba japonica</i>	B	<i>Syneilesis palmata</i>	A
<i>Helwingia japonica</i>	B	<b><i>Youngia yoshinoi</i></b>	A B
<i>Fraxinus sieboldiana</i>	A	<i>Brachypodium sylvaticum</i>	A
<i>Ligustrum obtusifolium</i>	A	<i>Cleistogenes hackelii</i>	A
<i>Gardeneria multiflora</i>	A	<i>Melica onoëi</i>	A
<i>Trachelospermum asiaticum</i>	A	<i>Miscanthus sinensis</i>	A
<i>Marsdenia tomentosa</i>	A	<i>Oplismenus undulatifolius</i>	
<i>Callicarpa japonica</i>	B	var. <i>japonicus</i>	A
<i>Isodon inflexus</i>	B	<i>Carex sp.</i>	B
<i>Salvia japonica</i>	A	<i>Arisaema shikokianum</i>	A
<i>Conandron ramondioides</i>	A	<i>Hosta longipes</i>	A B
<i>Galium pogonanthum</i>		<i>Ophiopogon japonicus</i>	A B

(3) Ikura to Shoden—When we take a route from Ikura to Shoden (150 m or so in altitude), very often we meet with escarpments of limestone along the river. Although the vegetation of their surroundings is almost destroyed by human activity, limestone bluffs are playing a role to retain some species of very rare occurrence in Japan. For example, *Rhodotypos scandens*, *Rhamnus yoshinoi*, *Vitis amurensis*, *Forsythia japonica* and *Youngia yoshinoi* are all growing thanks to these limestone bluffs. The following floristic list is concerned with the plants mainly from dry cliffs of Taniai, Ikura, Himehara, Nagaya, Hirose, Kawanose and Shoden, inclusively.

<i>Aleuritopteris argentea</i>	A	<i>Pteris multifida</i>	A
<i>Asplenium sarelii</i>	A	<i>Pyrrosia linearifolia</i>	A
<b><i>Camptosorus sibiricus</i></b>	A	<i>Selaginella tamariscina</i>	A
<i>Coniogramme intermedium</i>	A	<i>Torreya nucifera</i>	A B
<i>Cheilanthes chusana</i>	A	<i>Cephalotaxus harringtonia</i>	B
<i>Cyrtomium fortunei</i>		<i>Pinus densiflora</i>	A
var. <i>clivicolum</i>	A	<i>Juniperus rigida</i>	A
var. <i>fortunei</i>	A B	<i>Quercus acutissima</i>	A
<i>Cyclosorus acuminata</i>	A B	<i>Q. glauca</i>	B
<i>Equisetum arvense</i>	A	<i>Q. myrsinaefolia</i>	B
<b><i>Hypodematium glanduloso-pilosum</i></b>	A	<i>Q. variabilis</i>	A
<i>Lastrea subochtodes</i>	A	<i>Celtis leveillei</i>	B
<i>Lemmaphyllum microphyllum</i>	A	<i>Ulmus parvifolia</i>	B
<i>Polystichum craspedosorum</i>	A	<i>Zelkova serrata</i>	A
<i>P. tsussimense</i>	A	<i>Brousonettia kazinoki</i>	A

<i>Ficus nipponica</i>	A	<i>Securinega suffruticosa</i>	A B
<i>Boehmeria grandifolia</i>	A	<b><i>Buxus microphylla</i></b>	
B. <i>nivea</i>		var. <i>japonica</i>	A
ssp. <i>nipponivea</i>	A	<i>Rhus chinensis</i>	A
B. <i>spicata</i>	A	R. <i>sylvestris</i>	A B
<i>Laportea bulbifera</i>	A	<i>Euonymus fortunei</i>	
<i>Pilea petiolaris</i>		var. <i>villosa</i>	A
ssp. <i>pseudopetiolaris</i>	A	<b><i>Rhamnus yoshinoi</i></b>	
<i>Aquilegia adoxoides</i>	A	var. <i>velvetina</i>	A
<i>Anemone hupehensis</i>		var. <i>yoshinoi</i>	A
var. <i>japonica</i>	A	<i>Ampelopsis brevipedunculata</i>	A
<i>Clematis stans</i>	A	<i>Parthenicissus tricuspidatus</i>	A
C. <i>terniflora</i>	A	<i>Vitis amurensis</i>	A
<i>Thalictrum minus</i>		<i>Camellia japonica</i>	A
var. <i>hypoleucum</i>	A	<i>Viola grypoceras</i>	A
<i>Nandina domestica</i>	A B	<i>Stachyurus praecox</i>	A
<i>Menispermum dauricum</i>	B	<i>Elaeagnus pungens</i>	A
<i>Neolitsea sericea</i>	B	<i>Hedera rhombea</i>	A B
<i>Chelidonium majus</i>		<i>Peucedanum terebinthaceum</i>	A
ssp. <i>asiaticum</i>	A	<i>Seseli ugoensis</i>	A
<i>Arabis flagellosa</i>	A	<i>Aucuba japonica</i>	A B
<i>Sedum bulbiferum</i>	A	<i>Helwingia japonica</i>	A
S. <i>makinoi</i>	A	<i>Diospyros lotus</i>	A
S. <i>subtile</i>	A	<b><i>Forsythia japonica</i></b>	A
S. <i>verticillatum</i>	A	<i>Fraxinus sieboldiana</i>	A
S. <i>viride</i>	A	<i>Gardeneria multiflora</i>	A B
<i>Deinranthe bifida</i>	B	<i>Trachelospermum asiaticum</i>	A B
<i>Deutzia crenata</i>	A	<i>Ajuga nipponensis</i>	A B
D. <i>gracilis</i>	A	<i>Phtheirospermum japonicum</i>	A
<i>Hydrangea serrata</i>	B	<i>Justicia procumbens</i>	
<i>Philadelphus satsumi</i>		var. <i>leucantha</i>	A
var. <i>nikoensis</i>	A	<i>Galium pogonanthum</i>	A
<i>Ribes fasciculatum</i>	A	<i>Paederia scandens</i>	
<i>Saxifraga fortunei</i>		var. <i>mairei</i>	A
var. <i>incislobata</i>	A	<i>Rubia cordifolia</i>	
<i>Agrimonia pilosa</i>	B	var. <i>munjista</i>	A
<b><i>Eriobotrya japonica</i></b>	B	<i>Lonicera japonica</i>	A
<i>Kerria japonica</i>	A B	<b><i>Viburnum carlesii</i></b>	
<b><i>Rhodotypos scandens</i></b>	A	var. <i>bitchiuense</i>	B
(KOSAKA 1932)		V. <i>erosum</i>	A
<i>Rubus yoshinoi</i>	B	<b><i>Zabelia integrifolia</i></b>	B
<b><i>Spiraea nervosa</i></b>		<i>Patrinia villosa</i>	
var. <i>latifolia</i>	A	<i>Valeriana fauriei</i>	A
<i>Albizia julibrissin</i>	B	<i>Trichosanthes bracteata</i>	A
<i>Indigofera pseudotinctoria</i>	A	T. <i>multiloba</i>	B
<i>Wisteria brachybotrys</i>	A	<i>Artemisia keiskeana</i>	B
<i>Oxalis corniculata</i>		A. <i>princeps</i>	A B
var. <i>erecta</i>	A	<i>Aster ageratoides</i>	
<i>Zanthoxylum planispinum</i>	A B	ssp. <i>leiophyllus</i>	A B
<i>Mallotus japonicus</i>	A	<i>Erigeron annuus</i>	A
		<i>Saussurea pulchella</i>	B



Youngia denticulata	A	Setaria viridis	A
Y. japonica	A	Carex brunnea	
Y. yoshinoi	A	var. nakiri	A
Calamagrostis arundinacea		Trachycarpus fortunei	B
var. brachtricha	A B	Escaped.	
Melica onoei	A	Allium tuberosum	A
Microstegium japonicum	A	Asparagus lucidus	A
Miscanthus sinensis	A B	Liriope platyphylla	A B
Oplismenus undulatifolius	B	Dioscorea quinqueloba	A
Poa annua	A	Sisyrinchium atlanticum	A
P. sphondylodes	A		

#### 41. Upper Nariwa river (Pref. Okayama)

The upper district of the Nariwa river is another limestone region of Pref. Okayama. TERA0 (1955) studied the vegetation on cliffs and rubbly stands at the valley of Bankutsu-kei and in the way from Shito to Yose. In the former, according to his statements, *Philadelphus satsumi*, *Spiraea nervosa*, *Securinega suffruticosa*, *Conandron ramondioides* and *Youngia yoshinoi* are the dominant species on cliffs, whereas *Quercus glauca*, *Machilus japonica*, *Picrasma quassioides*, *Acer palmatum*, *Helwingia japonica*, *Fraxinus sieboldiana* and *Marsdenia tomentosa* are fairly abundant. In the latter, cliffs are abundantly inhabited by *Ficus nipponica*, *Zanthoxylum planispinum*, *Gardeneria multiflora*, *Artemisia keiskeana* and *Youngia yoshinoi*, while there dominantly grow *Juniperus sargentii*, *Carpinus laxiflora*, *Quercus serrata*, *Lindera obtusiloba*, *Deutzia gracilis*, *Spiraea nervosa* var. *latifolia*, *Picrasma quassioides* and *Trachelospermum asiaticum* on the rubbly stands.

The following plants which are concerned with the above two fields are all extracted from TERA0 (1955).

<b>Asplenium ruta-muraria</b>	A	<i>Celtis sinensis</i>	
A. sarelii	A	var. japonica	A
<b>Camptosorus sibiricus</b>	A	<i>Zelkova serrata</i>	A B
<i>Cyrtomium fortunei</i>	A	<i>Ficus nipponica</i>	A B
<i>Dryopteris lacera</i>	B	<i>Morus tiliaefolia</i>	B
<b>Hypodematium glanduloso-pilosum</b>	A	<i>Clematis apiifolia</i>	B
<i>Phyllitis scoropendrium</i>	B	C. stans	B
<i>Polystichum tsussimense</i>	B	<i>Pulsatilla cernua</i>	B
<i>Pteris multifida</i>	B	<i>Thalictrum actaeofolium</i>	A B
<i>Pyrrosia lingua</i>	B	<i>Akebia trifoliata</i>	B
<i>Selaginella tamariscina</i>	A B	<i>Epimedium diphyllum</i>	B
<i>Cephalotaxus harringtonia</i>	B	<i>Nandina domestica</i>	A B
<i>Juniperus rigida</i>	A	<i>Sinomenium acutum</i>	B
<b>J. sargentii</b>	A B	<i>Lindera glauca</i>	A
<i>Platycarya strobilacea</i>	B	L. obtusiloba	A B
<i>Pterocarya rhoifolia</i>	B	<i>Machilus japonica</i>	B
<i>Carpinus laxiflora</i>	A	<i>Neolitsea sericea</i>	B
<i>Quercus glauca</i>	B	<i>Parabenzoin praecox</i>	B
Q. serrata	B	<i>Arabis flagellosa</i>	A

<i>Sedum makinoi</i>	A B	var. <i>trilobum</i>	A B
<i>Deutzia gracilis</i>	A B	<i>Hedera rhombea</i>	B
<i>Philadelphus satsumi</i>	A B	<i>Aucuba japonica</i>	A
<i>Saxifraga fortunei</i>		<i>Helwingia japonica</i>	A B
var. <i>incislobata</i>	A	<i>Lyonia elliptica</i>	B
<i>Amelanchier asiatica</i>	B	<i>Pieris japonica</i>	B
<b><i>Eriobotrya japonica</i></b>	A	<i>Rhododendron kaempferi</i>	A B
<i>Kerria japonica</i>	B	<i>Ardisia japonica</i>	B
<i>Rosa</i> sp.	A	<i>Lysimachia clethroides</i>	B
<b><i>Spiraea nervosa</i></b>		<i>Diospyros kaki</i>	
var. <i>latifolia</i>	A B	var. <i>sylvestris</i>	B
<i>Stephanandra incisa</i>	A B	<i>Fraxinus sieboldiana</i>	B
<i>Caesalpinia japonica</i>	A	<i>Ligustrum japonicum</i>	B
<i>Indigofera pseudotinctoria</i>	B	L. <i>obtusifolium</i>	B
<i>Lespedeza bicolor</i>	B	<i>Gardeneria multiflora</i>	A
L. <i>virgata</i>	B	<i>Trachelospermum asiaticum</i>	A
<i>Orixa japonica</i>	B	<i>Marsdenia tomentosa</i>	A B
<i>Zanthoxylum planispinum</i>	A B	<i>Ajuga nipponensis</i>	A B
Z. <i>schinifolium</i>	B	<i>Salvia japonica</i>	B
<i>Picrasma quassioides</i>	B	<i>Ellisiophyllum reptans</i>	B
<i>Mercurialis leiocarpa</i>	B	<i>Conandron ramondioides</i>	A B
<i>Phyllanthus flexuosus</i>	B	<i>Abelia serrata</i>	B
<i>Sapium japonicum</i>	B	A. <i>spathulata</i>	B
<i>Securinega suffruticosa</i>	A B	A. <i>tetrasepala</i>	A
<b><i>Buxus microphylla</i></b>		<i>Viburnum erosum</i>	B
var. <i>japonica</i>	B	<i>Artemisia keiskeana</i>	A B
<i>Ilex chinensis</i>	B	<i>Aster ageratoides</i>	
I. <i>crenata</i>	B	ssp. <i>leiophyllum</i>	B
I. <i>pedunculosa</i>	B	<i>Leibnitzia anandria</i>	B
<i>Euonymus fortunei</i>		<i>Picris hieracoides</i>	
var. <i>radicans</i>	A	ssp. <i>japonica</i>	B
<i>Acer palmatum</i>	B	<i>Syneilesis palmata</i>	B
A. <i>rufinerve</i>	B	<b><i>Youngia yoshinoi</i></b>	A B
<i>Ampelopsis brevipedunculata</i>	B	<i>Arthraxon hispidus</i>	B
<i>Parthenocissus tricuspidatus</i>	A	<i>Carex siderosticta</i>	B
<i>Camellia japonica</i>	B	<i>Polia japonica</i>	B
<i>Eurya japonica</i>	B	<i>Allium thunbergii</i>	B
<i>Viola ovato-oblonga</i>	B	<i>Lilium maximowiczii</i>	B
<i>Diplomorpha shikokiana</i>	A	<i>Smilax china</i>	B
<i>Elaeagnus umbellata</i>	B	<i>Dioscorea quinqueloba</i>	B
<i>Alangium platanifolium</i>		D. <i>tokoro</i>	B

#### 42. Taishakukyo (Pref. Hiroshima)

In the northeastern part of Pref. Hiroshima, there is a well-known scenic spot named Taishaku-kyo. It is a valley overhanged by high limestone walls in the distance of more than 5km, though they are sometimes replaced by conglomerates. Its altitude is about 400m on an average. HORIKAWA (1942) and HORIKAWA and SASAKI (1959) analysed the vegetation over the present area. The latter described an association from here, viz. Orixeto-Berche-

mietum berchemiaefoliae, which develops on shady gravelly slopes falling into the river. Zabelieto-Carpinetum turczaninovii and the *Quercus variabilis*-*Acer nikoense* community are the other vegetation types they accepted which are favorable on dry sunny ridges or cliffs and on gravelly mild slopes, respectively.

Floristically this area is much resembling the limestone fields of Pref. Okayama, retaining many common and rare species such as *Hypodematum glanduloso-pilosum*, *Rubus yoshinoi*, *Buxus microphylla* var. *insularis*, *Rhamnus yoshinoi* together with var. *velvetina*, *Diospyros lotus*, *Forsythia japonica*, *Viburnum carlesii* var. *bitchuense* and *Youngia yoshinoi*. The detectable plants are as below, some of which are quoted from HORIKAWA and SASAKI (1959).

<b>Asplenium ruta-muraria</b>	A	Boehemria nivea	
A. sarelii	A	ssp. nipononivea	B
Athyrium okuboanum	B	B. spicata	A
A. vidalii	B	Laportea macrostachya	B
<b>Camptosorus sibiricus</b>	A	Buckleya lanceolata	A
Coniogramme intermedium	B	Asarum caulescens	C
Cyrtomium fortunei	A B	Polygonum filiforme	B
Dennstaedtia wilfordii	A	Aconitum sp.	B
Dryopteris lacera	A	Clematis tosaensis	B
<b>Hypodematum glanduloso-pilosum</b>	A	Hepatica nobilis	
Phyllitis scoropendrium	A	var. japonica	
Polystichum craspedosorum	A	f. magna	A
P. tripterum	B	Thalictrum actaeofolium	A
P. tsussimense	A	T. minus	
Pteris multifida	A	var. stipellatum	B
Pyrosia hastata	B	Akebia quinata	A
Torreya nucifera	B	A. trifoliata	B
Cephalotaxus harringtonia	B	Epimedium diphyllum	B
Pinus densiflora	B	E. setosum	B
Juniperus chinensis	B	Berberis thunbergii	B
J. rigida	B	Lindera obtusiloba	B
Chloranthus japonicus	B	L. umbellata	B
Platycarya strobilacea	B	Corydalis incisa	C
Alnus pendula	B	Arabis flagellosa	A
Carpinus cordata	B	Cardamine leucantha	A
C. japonica	B	Sedum subtile	A
C. tschonokii	B	S. verticillatum	A
<b>C. turczaninovii</b>	B	Deinante bifida	B
Ostrya japonica	B	Deutzia crenata	A
Quercus aliena	B	D. gracilis	A
Q. serrata	B	Hydrangea serrata	B
Q. variabilis	B	Philadelphus satsumi	A
Celtis sinensis		Saxifraga cortusaefolia	A B
var. japonica	B	S. fortunei	
Zelkova serrata	B	var. incislobata	A
Brousonettia kazinoki	B	Schizophragma hydrangeoides	A
Morus tiliaefolia	B	Duchesnea indica	

var. leucocephala		<i>Ilex crenata</i>	B
f. japonica	A	<i>I. pedunculosa</i>	B
<i>Kerria japonica</i>	A	<i>Elaeagnus pungens</i>	B
<i>Prunus jamasakura</i>	B	<i>Alangium platanifolium</i>	
<i>Rubus yoshinoi</i>	B	var. <i>trilobum</i>	B
<i>Sorbus alnifolia</i>	B	<i>Hedera rhombea</i>	B
<b><i>Spiraea nervosa</i></b>		<i>Panax japonica</i>	B
var. <b><i>latifolia</i></b>	B	<i>Cryptotaenia canaednsis</i>	
<i>Stephanandra incisa</i>	B	ssp. <i>japonica</i>	B
<i>Lathyrus davidii</i>	B	<i>Seseli ugoensis</i>	A
<i>Lespedeza bicolor</i>	A	<i>Cornus controversa</i>	B
L. <i>homoloba</i>	A	C. <i>macrophylla</i>	A B
<i>Sophora flavescens</i>	B	<i>Helwingia japonica</i>	B
<i>Wisteria brachybotrys</i>	B	<i>Lysimachiaacroadenia</i>	B
<i>Orixa japonica</i>	B	<i>Diospyros lotus</i>	A
<i>Zanthoxylum planispinum</i>	A B	<b><i>Forsythia japonica</i></b>	A
<i>Picrasma quassioides</i>	B	<i>Fraxinus sieboldiana</i>	A
<i>Polygala japonica</i>	A	<i>Ligustrum obtusifolium</i>	B
<i>Mallotus japonicus</i>	B	<i>Trachelospermum asiaticum</i>	A
<i>Mercurialis leiocarpa</i>	B C	<i>Ancystrocarya japonica</i>	B
<b><i>Buxus microphylla</i></b>		<i>Lithospermum zollingeri</i>	B
var. <b><i>insularis</i></b>	A B	<i>Trigonotis peduncularis</i>	A
<i>Rhus ambigua</i>	B	<i>Callicarpa japonica</i>	B
R. <i>chinensis</i>	A	<i>Ajuga japonica</i>	B
<i>Euonymus alatus</i>		<i>Clinopodium multicaule</i>	B
f. <i>striatus</i>	A	<i>Isodon longitubus</i>	B
E. <i>fortunei</i>		<i>Lamium ambiguum</i>	B
var. <i>villosus</i>	A	<i>Meehania urticifolia</i>	B
<i>Staphylea bumalda</i>	B	<i>Prunella vulgaris</i>	
<i>Hosiea japonica</i>	B	ssp. <i>asiatica</i>	B
<i>Acer carpinifolium</i>	A B	<i>Phtheirospermum japonicum</i>	A
A. <i>cissifolium</i>	B	<i>Phacellanthus tubiflorus</i>	B
A. <i>mono</i>	B	<i>Conandron ramondioides</i>	A
A. <i>nikoense</i>	B	<i>Galium kinuta</i>	B
A. <i>palmatum</i>	B	G. <i>japonicum</i>	B
<i>Aesculus turbinata</i>	B	G. <i>pogonanthum</i>	
<i>Meliosma myriantha</i>	B	f. <i>trichopetalum</i>	B
<i>Berchemia racemosa</i>	B	<i>Hedyotis lindleyana</i>	
Leaves small mostly 1.5-2cm long.		var. <i>hirsuta</i>	B
<i>Berchemia berchemiaefolia</i>	B	<i>Paederia scandens</i>	
<b><i>Rhamnus yoshinoi</i></b>		var. <i>mairei</i>	B
var. <b><i>velvetina</i></b>	A	<i>Rubia chinensis</i>	
var. <b><i>yoshinoi</i></b>	A	var. <i>glabrescens</i>	B
<i>Ampelopsis brevipedunculata</i>	A	<i>Abelia spathulata</i>	B
<i>Parthenocissus tricuspidatus</i>	A	A. <i>tetrasepala</i>	A
<i>Vitis flexuosa</i>	B	<i>Lonicera gracilipes</i>	B
<i>Viola grypoceras</i>	A	<b><i>Viburnum carlesii</i></b>	
V. <i>mirabilis</i>	A	var. <b><i>bitchiuense</i></b>	B
var. <i>subglabra</i>	A	V. <i>erosum</i>	B
V. <i>ovato-oblonga</i>	A	<b><i>Zabelia integrifolia</i></b>	A B

<i>Patrinia villosa</i>	A	<i>Asperella longe-aristata</i>	A
<i>Valeriana fauriei</i>	B	<i>Brylkinia schmidtii</i>	A
<i>V. flaccidissima</i>	B	<i>Diarrhena japonica</i>	B
<i>Asyneuma japonicum</i>	B	<i>Miscanthus sinensis</i>	B
<b>Anaphalis sinica</b>	A	<i>Oplismenus undulatifolius</i>	
<i>Artemisia keiskeana</i>	A	var. <i>japonicus</i>	A B
<i>Aster ageratoides</i>		<i>Spodiopogon sibiricus</i>	A
ssp. <i>leiophyllus</i>	A	<i>Carex brunnea</i>	
<i>Atractylodes japonica</i>	A	var. <i>nakiri</i>	A
<i>Cacalia delphiniifolia</i>	B	<i>C. lanceolata</i>	B
<i>C. farfaraefolia</i>	A	<i>C. pisiformis</i>	B
<i>Carpesium glossophyllum</i>	B	<i>Arisaema robustum</i>	B
<i>Erigeron annuus</i>	A	<i>Chionographis japonica</i>	B
<i>Gnaphalium affine</i>	A	<i>Hosta longipes</i>	A
<i>Leibnitzia anandria</i>	A	<i>Liriope minor</i>	B
<i>Syneilesis palmata</i>	B	<i>L. platyphylla</i>	B
<i>Youngia denticulata</i>	A	<i>Ophiopogon japonicus</i>	A
<i>Y. japonica</i>	A	<i>Smilacina japonica</i>	B
<i>Y. yoshinoi</i>	A	<i>Smilax china</i>	B
<i>Agropyron ciliare</i>		<i>S. sieboldii</i>	B
var. <i>pilosum</i>	A	<i>Dioscorea tokoro</i>	B

### 3. Akiyoshidai (Pref. Yamaguchi)

Akiyoshidai is famous for its landscape with the vast limestone plateau (200m or so elev.) and some great limestone caves such as Shûhō-dô and Nakao-dô. Numerous big rocks of limestone are scattered on the plateau. Occasional escarpments are seen at its margin. Vegetationally the plateau itself is a grassland standing on deep red soils, the dominant members of which are *Pteridium aquilinum* var. *japonicum*, a well known calcifugous fern, some *Lespedeza* species, *Indigofera pseudotinctoria*, *Patrinia scabiosaeifolia*, *Adenophora triphylla* ssp. *aperticampanulata* and *Miscanthus sinensis*. On the other hand, the outcrops or gravelly places around the limestone caves are favouring the sparse woods comprising *Cephalotaxus harringtonia*, *Ficus erecta*, *Nandina domestica*, *Actinodaphne lancifolia*, *Neolitsea sericea*, *Aucuba japonica*, etc. Some calcicolous plants such as *Hypodematum glanduloso-pilosum*, *Polystichum deltodon* and *Eriobotrya japonica* are all strictly concerned with exposed limestone also around there. Apart from the calcifugous or indifferent members of the plateau, the plants collected on the limestone fields are as below.

<i>Asplenium sarelii</i>	A	<i>Polystichopsis simplicior</i>	A
<i>Cyrtomium falcatum</i>	A	<i>Pteris cretica</i>	A
<i>Diplazium wichurae</i>	A	<i>P. multifida</i>	A
<b><i>Hypodematum glanduloso-pilosum</i></b>	A	<i>Cephalotaxus harringtonia</i>	A B
<i>Lemmaphyllum microphyllum</i>	A	<i>Quercus glauca</i>	A B
<i>Neocheiropteris ensata</i>	A	<i>Ficus erecta</i>	A
<i>Onychium japonicum</i>	A	<i>Morus tiliaefolia</i>	A
<b><i>Polystichum deltodon</i></b>	A	<i>Pilea petiolaris</i>	
<i>P. tsussimense</i>	A	ssp. <i>pseudopetiolaris</i>	B

<i>Thalictrum minus</i>		<i>E. fortunei</i>	
var. <i>hypoleucum</i>	A	var. <i>villosus</i>	A
<i>Nandina domestica</i>	A	<i>Elaeagnus pungens</i>	A
<i>Actinodaphne lancifolia</i>	A	<i>Aucuba japonica</i>	A
<i>Neolitsea sericea</i>	A	<i>Cornus macrophylla</i>	A
<b><i>Eriobotrya japonica</i></b>	A	<i>Ardisia japonica</i>	A
<i>Picrasma quassioides</i>	A	<i>Ligustrum japonicum</i>	A
<i>Mallotus japonicus</i>	A	L. <i>obtusifolium</i>	A
<i>Rhus chinensis</i>	A	<i>Siphonostegia chinensis</i>	A
<i>Euonymus alatus</i>		<i>Polygonatum lasianthum</i>	A
f. <i>striatus</i>	A		

## SHIKOKU

## 44. Mt. Tsurugi (Pref. Tokushima)

At the elevation of about 1700m to 1800m in Mt. Tsurugi (1955m elev.) limestone is exposed forming some delimited fields such as Daiken and Shoken. According to YAMANAKA (1954 b), limestone is dominantly inhabited by *Thalictrum minus* var. *hypoleucum* and *Spiraea blumei*. The following list owes to him and also to the specimens available to me.

<b><i>Asplenium capillipes</i></b>	A	<i>Aruncus dioicus</i>	
A. <i>ruta-muraria</i>	A	var. <i>tenuifolius</i>	A
A. <i>viride</i>	A	<b><i>Potentilla fruticosa</i></b>	
<b><i>Camptosorus sibiricus</i></b>	A	var. <i>mandshurica</i>	A
<i>Cystopteris fragilis</i>	A	<i>Spiraea blumei</i>	A
<b><i>Gymnocarpium jessoense</i></b>	A	<b><i>Geranium robertianum</i></b>	A
<i>Polystichum craspedosorum</i>	A	<i>Tilingia tachiroei</i>	A
<b><i>Woodsia hancockii</i></b>	A	<i>Lonicera strophiphora</i>	
<i>Thalictrum minus</i>		var. <i>glabra</i>	B
var. <i>hypoleucum</i>	A	<i>Valeriana fauriei</i>	A
<i>Arabis serrata</i>		<i>Carex duvaliana</i>	A
var. <i>shikokiana</i>	A	<i>C. multifolia</i>	A
A. sp.	A		

## 45. Mt. Ishidate (Pref. Kochi)

As announced by YAMANAKA (1953), the vegetation of Mt. Ishidate (1724m elev.) is roughly represented by *Abies* and *Tsuga* (to 1200m alt.), *Fagus* (1200m to 1650m) and *Sasa* (summit). Such vegetations, however, are much modified on the occasional limestone fields throughout the mountain, where there occur some light bushes including *Philadelphus satsumi* var. *lancifolia*, *Orixa japonica* and *Staphylea bumalda* in the case of rubbly slopes or in cluding *Spiraea blumei*, *Zabelia integrifolia*, etc. in the case of outcrops.

The following list, partly owing to YAMANAKA (1953, 1954), is concerned with the plants from several limestone fields scattered on the mountainsides.

<i>Cyrtomium fortunei</i>	B	<b><i>Gymnocarpium jessoense</i></b>	A
<i>Dennstaedtia wilfordii</i>	A	<i>Polystichum craspedosorum</i>	A

Cephalotaxus harringtonia	B	S. japonica	A
Abies homolepis	A	Stephanandra incisa	A
<b>Juniperus sargentii</b>	A	Lespedeza buergeri	B
Chloranthus serratus	B	<b>Geranium robertianum</b>	A
Carpinus japonica	A	G. shikokianum	A
<b>C. tureczaninovii</b>	A	G. tripartitum	B
Boehmeria spicata	A	Orixa japonica	B
Buckleya lanceolata	B	Zanthoxylum schinifolium	A
Polygonum bistorta	A	Mercurialis leiocarpa	B
P. cuspidatum	B	Rhus chinensis	A
P. suffultum	B	Euonymus alatus	A B
Rumex acetosa	B	Staphylea bumalda	B
Melandryum yanoei	A	Acer mono	B
Pseudostellaria heterantha	A	Rhamnella franguloides	B
Euptelea polyandra	B	Rhamnus japonica	
Cimicifga acerina	B	var. microphylla	A B
<b>Clematis stans</b>		<b>R. yoshinoi</b>	B
var. <b>austro-japonensis</b>	A B	Tilia japonica	B
C. tosaensis	A	Viola biflora	A
Paeonia japonica	A	V. verecunda	B
Thalictrum minus		Diplomorpha shikokiana	B
var. hypoleucum	A	Elaeagnus pungens	B
Akebia quinata	B	Angelica shikokiana	A
Berberis thunbergii	B	Bupleurum longiradiatum	
Epimedium grandiflorum	A	f. elatius	B
Lindera glauca	B	Heracleum lanatum	
L. obtusiloba	B	var. tsurugisanense	B
Sedum aizoon		Cornus macrophylla	B
ssp. kantschaticum	A	Helwingia japonica	B
S. makinoi	A	Primula farinosa	
Deutzia crenata	B	ssp. modesta	A
D. gracilis	A	Fraxinus sieboldiana	B
Parnassia palustris	A	Ligustrum obtusifolium	B
Philadelphus satsumi		L. tschonoskii	A
var. lancifolius	B	Swertia bimaculata	B
Saxifraga fortunei		Euphrasia microphylla	A
var. incisolobata	A	Pinguicula vulgaris	A
S. sendaica		Galium gracilens	A
f. laciniata	A	G. kinuta	B
Tanakaea radicans	A	Abelia tetrasepala	A
Hamamelis japonica	A	<b>Zabelia integrifolia</b>	A
Aruncus dioicus		Valeriana flaccidissima	B
var. tenuifolius	A	Scabiosa japonica	B
<b>Filipendula tsuguwoi</b>	B	Adenophora remotiflora	A
Kerria japonica	B	<b>Anaphalis sinica</b>	B
Potentilla dickinsii	A	Aster ageratoides	
<b>P. fruticosa</b>		ssp. ovatus	B
var. <b>mandshurica</b>	A	Chrysanthemum makinoi	A
Rosa sp.	B	Cirsium gyojanum	A
Spiraea blumei	A B	Leontopodium japonicum	

var. spatulatum	A	<b>S. vaginata</b>	
Ligularia stenocephala	B	var. stans	B
Pertya glabrescens	B	Tofieldia coccinea	
<b>Saussurea amabilis</b>	A	var. kondoi	A
Youngia japonica	A	Veratrum maackii	B
Miscanthus sinensis	B	Iris japonica	B
Carex duvaliana	A	Gymnadenia cucullata	A
Hosta longipes	A	Microstylis monophyllos	A
Smilax sieboldii	B		

#### 46. Ryugado (Pref. Kochi)

At about 20km east of Kochi, there is a well known limestone cave named Ryuga-do around which limestone furnishes escarpments or rocky sites. YAMANAKA (1954) analysed the vegetation covering these fields and recognized three plant communities, viz. of pine, oak and kerria. The floristic members detected are as below.

<b>Asplenium coenobiale</b>	A	<b>Sedum tosaense</b>	A
A. wilfordii	A	Deutzia crenata	A
<b>Camptosorus sibiricus</b>	A	D. scabra	A
Cyrtomium falcatum	A	Pittosporum tobira	A
Cyclosorus acuminatus	B	<b>Eriobotrya japonica</b>	B
<b>Cyrtomium caryotideum</b>	B	Kerria japonica	B
<b>Hypodematium glanduloso-pilosum</b>	A	Pourthiaea villosa	
Onychium japonicum	A	var. laevis	B
Lemmaphyllum microphyllum	A	Prunus sp.	B
Polystichopsis aristata	B	Rosa multiflora	A
Pyrrosia lingua	A	R. wichurajana	B
Selaginella involvens	A	Rubus buergeri	B
Cephalotaxus harringtonia	B	Albizia julibrissin	B
Pinus densiflora	B	Indigofera pseudotinctoria	B
Cryptomeria japonica	B	Lespedeza buergeri	B
Piper kadzura	A	Pueraria lobata	B
Castanopsis cuspidata	B	Picrasma quassioides	A B
Quercus acutissima	B	Mallotus japonicus	A
Q. glauca	B	Rhus sylvestris	B
Q. serrata	B	Ilex crenata	B
Celtis sinensis		Celastrus orbiculatus	B
var. japonica	B	Euonymus alatus	A
Ficus erecta	A	E. fortunei	
F. stipulata	A	var. radicans	A
Boehmeria spicata	A	Acer palmatum	B
Clematis apiifolia	B	Berchemia racemosa	A
Thalictrum minus		Ampelopsis brevipedunculata	A
var. hypoleucum	A	Parthenocissus tricuspidatus	A
Akebia quinata	B	Vitis coignetiae	B
A. trifoliata	B	V. sacharifera	B
Nandina domestica	A	Camellia japonica	B
Cinnamomum japonicum	B	Xylosma japonica	B
Neolitsea sericea	B	Elaeagnus pungens	B



Hedera rhombea	A	Y. denticulata	A
Helwingia japonica	B	Serratula corniculata	
Diospyros kaki		ssp. insularis	B
var. sylvestris	B	Arundinella hirta	B
Ligustrum japonicum	A	Miscanthus sinensis	B
L. obtusifolium	A	Oplismenus undulatifolius	
Trachelospermum asiaticum	A	var. japonicus	B
Viburnum dilatatum	B	Carex brunnea	
Galium gracilens	A	var. nakiri	A
G. pogonanthum	A	Trachycarpus fortunei	B
Patrinia villosa	B	Pinellia tripartita	A
Artemisia japonica	B	Allium grayi	A
Aster ageratoides		Asparagus lucidus	A
ssp. amplexifolius	B	Liriope platyphylla	B
Chrysanthemum indicum	B	Smilax china	B
C. makinoi	B	Dioscorea tokoro	B
Youngia japonica	A		

#### 47. Tosayama (Pref. Kochi)

The limestone hills (100-150m elev.) standing on both sides of the Kagami-gawa in Tosayama-mura, north of Kochi, present us everywhere exposed cliffs and sunny rubbly sites on the hillsides. YAMANAKA (1956) outlined the flora and vegetation of this region. As described and reported by him (1955, 1956), the associations recognized are Orixetum japonicae on the shady and humid rubbly slopes, Nandineto-Quercetum glaucae on rather dry slopes and Zabelieto-Carpinetum turczaninovii at sunny rubbly ridges. The cliffs are often inhabited by *Clematis williamsii*, *Platycrater arguta*, *Eriobotrya japonica*, *Spiraea nervosa*, *Lespedeza buergeri*, *Securinega suffruticosa* and rarely by *Asplenium coenobiale*, *Polystichum deltodeon*, *Sedum tosaense* and *Angelica saxicola* var. *yoshinagae*.

These and other plants detectable are in the following list.

<b>Asplenium coenobiale</b>	A	Celtis sinensis	
<b>Camptosorus sibiricus</b>	A	var. japonica	B
<b>Cyrtomium caryotideum</b>	B	Brousonettia kazinoki	B
C. fortunei		Ficus erecta	A B
var. clivicolum	B	F. nipponica	A
var. fortunei	B	Morus bombycis	B
Lemmaphyllum microphyllum	A	Boehmeria spicata	A B
Lepisorus thunbergianus	B	Polygonum cuspidatum	B
Onychium japonicum	A	Euptelea polyandra	B
Polystichum craspedosorum	A	Clematis apiifolia	B
P. <b>deltodon</b>	A	C. terniflora	B
P. tsussimense	A	<b>C. williamsii</b>	A B
Pteris multifida	A	Thalictrum minus	
Torreya nucifera	B	var. hypoleucum	A B
Cephalotaxus harringtonia	B	Akebia quinata	B
Chloranthus japonicus	B	A. trifoliata	B
<b>Carpinus turczaninovii</b>	B	Epimedium grandiflorum	B
Quercus glauca	B	Nandina domestica	B

<i>Cocculus trilobus</i>	B	f. <i>striatus</i>	A B
<i>Sinomenium acutum</i>	B	E. <i>fortunei</i>	
<i>Machilus japonica</i>	A	var. <i>radicans</i>	B
<i>Cinnamomum japonicum</i>	B	E. <i>oxyphyllus</i>	B
<i>Neolitsea sericea</i>	B	<i>Staphylea bumalda</i>	B
<i>Lindera glauca</i>	B	<i>Acer palmatum</i>	B
<i>Macleaya cordata</i>	B	<i>Berchemia racemosa</i>	B
<i>Arabis serrata</i>		<b><i>Rhamnus yoshinoi</i></b>	A B
var. <i>shikokiana</i>	A	<i>Ampelopsis brevipedunculata</i>	B
<b><i>Sedum tosaense</i></b>	A	<i>Parthenocissus tricuspidatus</i>	B
<i>Pittosporum tobira</i>	B	<i>Camellia japonica</i>	B
<i>Deutzia gracilis</i>	A	<i>Viola ovato-oblonga</i>	A
D. <i>maximowicziana</i>	B	<i>Xylosma japonica</i>	B
D. <i>scabra</i>	B	<i>Stachyurus praecox</i>	B
<i>Platycrater arguta</i>	A B	<i>Elaeagnus pungens</i>	B
<i>Hydrangea hirsuta</i>	B	<i>Alangium platanifolium</i>	
<i>Philadelphus satsumi</i>	B	var. <i>trilobum</i>	B
<i>Saxifraga stolonifera</i>	B	<i>Hedera rhombea</i>	B
<b><i>Eriobotrya japonica</i></b>	A	<b><i>Angelica saxicola</i></b>	
<i>Kerria japonica</i>	A B	var. <i>yoshinagae</i>	A B
<i>Pourthiaea villosa</i>	B	<i>Chamaele decumbens</i>	B
<i>Rosa multiflora</i>	A	<i>Sanicula chinensis</i>	B
<i>Rubus buergeri</i>	B	<i>Aucuba japonica</i>	B
R. <i>crataegifolius</i>	A B	<i>Cornus macrophylla</i>	B
R. <i>hakonensis</i>	B	<i>Helwingia japonica</i>	A B
R. <i>parvifolius</i>	B	<i>Ardisia japonica</i>	B
<b><i>Spiraea nervosa</i></b>		<i>Diospyros kaki</i>	
var. <i>latifolia</i>	A	var. <i>sylvestris</i>	B
var. <i>nervosa</i>	A B	<i>Fraxinus sieboldiana</i>	B
<i>Stephanandra incisa</i>	B	<i>Ligustrum japonicum</i>	B
<i>Caesalpinia japonica</i>	B	L. <i>obtusifolium</i>	B
<i>Lespedeza buergeri</i>	A B	<i>Gardeneria nutans</i>	B
<i>Pueraria lobata</i>	B	<i>Trachelospermum asiaticum</i>	B
<i>Orixa japonica</i>	A B	<i>Isodon longitubus</i>	B
<i>Zanthoxylum piperitum</i>	B	<i>Keiskea japonica</i>	A
Z. <i>planispinum</i>	A	<i>Galium pogonanthum</i>	A
<i>Picrasma quassioides</i>	B	<i>Paederia scandens</i>	
<i>Melia azedarach</i>		var. <i>mairei</i>	A B
var. <i>subtripinnata</i>	B	<i>Abelia spathulata</i>	B
<i>Polygala japonica</i>	A B	<i>Lonicera japonica</i>	B
<i>Euphorbia sieboldiana</i>	A	<i>Viburnum dilatatum</i>	B
<i>Mallotus japonicus</i>	A B	V. <i>erosum</i>	B
<i>Mercurialis leiocarpa</i>	B	<b><i>Zabelia integrifolia</i></b>	B
<i>Securinega suffruticosa</i>	A	<i>Aster ageratoides</i>	
<i>Sapium japonicum</i>	B	ssp. <i>leiophyllus</i>	B
<b><i>Buxus microphylla</i></b>		ssp. <i>ovatus</i>	B
var. <i>japonica</i>	A	<i>Carpesium abrotanoides</i>	B
<i>Rhus sylvestris</i>	B	<i>Chrysanthemum indicum</i>	A B
<i>Celastrus orbiculatus</i>	B	<i>Ixeris stolonifera</i>	B
<i>Euonymus alatus</i>		<i>Youngia denticulata</i>	B

Brachypodium sylvaticum	A B	Chionographis japonica	A
Miscanthus sinensis	A	Hosta tozana	B
Oplismenus undulatifolius		Lilium speciosum	B
var. japonicus	B	Liriope platyphylla	B
Carex brunnea		Ophiopogon japonicus	B
var. nakiri	B	Smilax china	B
C. makinoensis	A B	S. sieboldii	B
Pinellia tripartita	B	Dioscorea gracillima	B
Alectrurus yedoensis	A	Iris japonica	B
Asparagus lucidus	B	Cymbium virescens	B

## 48. Mt. Yokogura (Pref. Kochi)

Mt. Yokogura (800m elev.), situated at about 30km west of Kochi, is one of the botanically famous mountains, for some plants such as *Rhamnella berchemiaefolia* (= *Berchemia berchemiaefolia*), *Vitis yokogurana* (= *V. saccharifera* var. *yokogurana*), *Adenophora maximowicziana* and *Tricyrtis macrantha* were originally reported from the present mountain. Geologically, it is constructed by the Pre-carboniferous limestone, which is exposed to be a rocky sunny field on the summit region. As described and reported by YAMANAKA (1955, 1956), the vegetation on this rocky field belongs to Zabelieto-Carpinetum turczaninovi accompanied by *Spiraea nervosa*, *Lespedeza buergeri*, *Abelia serrata* and so on. The following list is based on YAMANAKA (1956) and my own observation.

<b>Asplenium ruta-muraria</b>	A	Sapium japonicum	B
<b>Camptosorus sibiricus</b>	A	Euonymus alatus	
<b>Hypodematum glanduloso-pilosum</b>	A	f. striatus	A
Polystichum craspedosorum	B	Berchemia berchemiaefolia	B
Torreya nucifera	B	Ampelopsis brevipedunculata	A
Cephalotaxus harringtonia	B	Parthenocissus tricuspidata	A
Abies firma	B	Vitis saccharifera	
<b>Carpinus turczaninovi</b>	A B	var. yokogurana	A
Quercus acuta	B	Viola grypoceras	A
Morus bombycis	B	V. ovato-oblonga	A
Boehmeria spicata	A	Lysimachia shikokiana	B
Pilea japonica	A	Diospyros kaki	
<b>Clematis williamsii</b>	A	var. sylvestris	A
Thalictrum actaeifolium	A	Symplocos myrtacea	B
T. minus		Fraxinus sieboldiana	A B
var. hypoleucum	A	Callicarpa japonica	B
Berberis thunbergii	A	C. mollis	B
Actinodaphne lancifolia	B	Keiskea japonica	B
Agrimonia pilosa	B	Galium pogonanthum	A
Potentilla dickinsii	A	Paederia scandens	
<b>Spiraea nervosa</b>		var. mairei	A B
var. latifolia	B	Abelia serrata	A B
var. nervosa	A B	Viburnum dilatatum	B
Lespedeza buergeri	A B	<b>Zabelia integrifolia</b>	A B
Zanthoxylum planispinum	A B	<b>Anaphalis sinica</b>	A
Mercurialis leiocarpa	B	Artemisia keiskeana	A

<i>Aster ageratoides</i>		<i>Miscanthus sinensis</i>	A B
ssp. <i>amplexifolius</i>	A	<i>Carex makinoensis</i>	A
<i>Cirsium yoshinoi</i>		<i>Pinellia tripartita</i>	A
var. <i>shikokianum</i>	B	<i>Alectorurus yedoensis</i>	A
<i>Youngia denticulata</i>	A	<b><i>Tricyrtis macrantha</i></b>	A
<i>Brachypodium sylvaticum</i>	A	<i>Orchis graminifolia</i>	A

#### 49. Mt. Torigata (Pref. Kochi)

Mt. Torigata (1460m elev.), situated more than 40km west of Kochi, also stands on the limestone lode. Around the summit and on the eastern side of the mountain, limestone is found exposed to some extent. YAMANAKA and MORISHITA (1956) studied the vegetation there, reporting that the forests with *Carpinus japonica*, *Zelkova serrata* and *Euptelea polyandra* dominant or the bushes with *Orixa japonica* dominant were recognizable on rocky slope along the stream, while on the summit Zabelieto-Carpinetum turczaninovii was distinctly acceptable. According to YAMANAKA and MORISHITA (1956) and my own record the plants from the former are:

<i>Athyrium mesosorum</i>	B	<i>Lespedeza buergeri</i>	B
<b>Camptosorus sibiricus</b>	A	<i>Pueraria lobata</i>	B
<b>Cyrtomium caryotideum</b>	B	<i>Orixa japonica</i>	B
C. <i>fortunei</i>	A	<i>Zanthoxylum piperitum</i>	B
<i>Dryopteris lacera</i>	B	<i>Picrasma quassioides</i>	B
<i>Torreya nucifera</i>	B	<i>Mallotus japonicus</i>	B
<i>Cephalotaxus harringtonia</i>	B	<i>Mercurialis leiocarpa</i>	B
<i>Chloranthus japonicus</i>	B	<i>Celastrus orbiculatus</i>	B
<i>Carpinus japonica</i>	B	<i>Euonymus melananthus</i>	B
<b>C. turczaninovii</b>	A B	E. <i>oxyphyllus</i>	A
<i>Zelkova serrata</i>	B	<i>Hosiea japonica</i>	B
<i>Morus bombycis</i>	B	<i>Acer carpiniifolium</i>	B
<i>Polygonum cuspidatum</i>	B	A. <i>palmatum</i>	B
<i>Euptelea polyandra</i>	B	<i>Berchemia berchemiaefolia</i>	B
<i>Clematis apiifolia</i>	B	<i>Ampelopsis brevipedunculata</i>	B
<i>Thalictrum actaeifolium</i>	B	<i>Stachyurus praecox</i>	B
<i>Akebia trifoliata</i>	B	<i>Alangium platanifolium</i>	
<i>Berberis thunbergii</i>	A	var. <i>trilobum</i>	B
<i>Sinomenium acutum</i>	B	<i>Hedera rhombea</i>	B
<i>Lindera obtusiloba</i>	B	<i>Cornus macrophylla</i>	B
L. <i>praecox</i>	B	<i>Helwingia japonica</i>	B
<i>Deutzia crenata</i>	B	<i>Diospyros kaki</i>	
D. <i>gracilis</i>	A	var. <i>sylvestris</i>	B
D. <i>maximowicziana</i>	B	<i>Fraxinus sieboldiana</i>	B
<i>Philadelphus satsumi</i>	A	<i>Ligustrum obtusifolium</i>	B
<b>Filipendula tsuguwoi</b>	A	<i>Cynanchum</i> sp.	B
(YAMANAKA 1962)		<i>Tylophora aristolochioides</i>	B
<i>Kerria japonica</i>	A	<i>Galium pogonanthum</i>	B
<i>Prunus jamasakura</i>	B	<i>Paederia scandens</i>	
<i>Rosa</i> sp.	B	var. <i>mairei</i>	B
<i>Rubus hirsutus</i>	B	<i>Abelia tetrasepala</i>	B
<i>Stephanandra incisa</i>	B	<i>Lonicera ramosissima</i>	A

Viburnum erosum	B	(YAMANAKA 1962)	
V. plicatum		Pertya glabrescens	B
var. tomentosum	A	Brachypodium sylvaticum	B
<b>Zabelia integrifolia</b>	B	Miscanthus sinensis	B
Codonopsis lanceolata	B	Carex duvaliana	A
Aster ageratoides		Ophiopogon japonicus	B.
ssp. amplexifolius	B	Smilax sieboldii	B
Artemisia keiskeana	B	Lycoris sanguinea	B
Chrysanthemum indicum	B	Cymbium virescens	B.
C. <b>zawadskii</b>	A		

And those from the latter are:

Polystichum craspedosorum	A	Acer sieboldianum	B.
Abies homolepis	B	Rhamnus japonica	
Salix sp.	B	var. microphylla	B.
Carpinus japonica	B	Viola grypoceras	A
C. <b>turczaninovii</b>	A	Diplomorpha albiflora	B.
Corylus sieboldiana	B	Cornus kousa	B
Fagus crenata	B	Helwingia japonica	B.
Quercus mongolica		Enkianthus cernuus	
var. grosseserrata	B	f. rubens	B.
<b>Clematis stans</b>		Rhododendron reticulatum	B.
var. <b>austro-japonensis</b>	A B	Fraxinus sieboldiana	B.
Paeonia japonica	B	Melampyrum laxus	
Thalictrum minus		var. brevidens	B.
var. hypoleucum	A B	Pedicularis resupinata	B.
Berberis thunbergii	B	Abelia tetrasepala	B.
Parabenzoin trilobum	B	Lonicera ramosissima	B.
Sedum aizoon		Viburnum erosum	B
ssp. kamtschaticum	A	<b>Zabelia integrifolia</b>	B.
Astilbe thunbergii	B	Aster ageratoides	
Deutzia gracilis	A	ssp. amplexifolius	A
Hydrangea paniculata	B	<b>Chrysanthemum zawadskii</b>	
H. serrata	B	(YAMANAKA 1962)	
Agrimonia pilosa	A	Pertya glabrescens	B.
Rosa sp.	B	Brachypodium sylvaticum	B
<b>Spiraea nervosa</b>	B	Miscanthus sinensis	A B
Rhus ambigua	A B	Carex duvaliana	A B.
Euonymus alatus		C. siderosticta	B
f. striatus	B	Veratrum maackii	A B
E. oxyphyllus	B		

#### 50. Mimido (Pref. Ehime)

Some small limestone hills (350m-400m elev.) lie at the jointing area of the two rivers, Omogo-gawa and Kuma-gawa, and at about 8.5km southeast of Kuma-cho. TOKUI (1953) and YAMANAKA and MORISHITA (1956) reported the vegetation and flora of these hills. As the latter pointed out, the vegetation at sunny rubbly ridges is represented by Zabelieto-Carpinetum turczaninovii

accompanying *Spiraea nervosa* and *Lespedeza buergeri*, and on shady gravelly slopes by the light forest of *Torreya nucifera*, *Quercus glauca* and *Q. salicina*.

The following list mostly owes to YAMANAKA and MORISHITA (1956).

<i>Asplenium incisum</i>	A	<i>Rhynchosia acuminatifolia</i>	B
A. <i>pekinense</i>	A	<i>Zanthoxylum piperitum</i>	B
A. <i>ruta-muraria</i>	A	Z. <i>planispinum</i>	A
<b>Camptosorus sibiricus</b>	A	Z. <i>schinifolium</i>	B
<i>Coniogramme intermedium</i>	A	<i>Rhus chinensis</i>	B
<i>Cyrtomium fortunei</i>	B	<i>Euonymus alatus</i>	
<i>Davallia mariesii</i>	A	<i>f. striatus</i>	B
<i>Dryopteris lacera</i>	B	<i>Acer mono</i>	B
<b>Hypodematium glanduloso-pilosum</b>	A	A. <i>nikoense</i>	B
<i>Lemmaphyllum microphyllum</i>	A	A. <i>palmatum</i>	B
<i>Lepisorus thunbergianus</i>	A	<i>Meliosma tenuis</i>	B
<i>Polystichum craspedosorum</i>	A	<i>Parthenocissus tricuspidatus</i>	B
<i>Pteris cretica</i>	A	<i>Camellia japonica</i>	B
P. <i>multifida</i>	A	<i>Eurya japonica</i>	B
<i>Pyrrosia linearifolia</i>	A	<i>Elaeagnus pungens</i>	B
<i>Torreya nucifera</i>	A B	<i>Hedera rhombea</i>	B
<i>Cephalotaxus harringtonia</i>	B	<i>Angelica shikokiana</i>	A
<i>Pinus densiflora</i>	B	<i>Helwingia japonica</i>	B
<b>Carpinus turczaninowii</b>	A	<i>Rhododendron kaempferi</i>	B
<i>Quercus glauca</i>	A B	R. <i>reticulatum</i>	B
Q. <i>salicina</i>	B	<i>Ardisia japonica</i>	B
Q. <i>serrata</i>	B	<i>Fraxinus sieboldiana</i>	A B
<i>Celtis sinensis</i>		<i>Ligustrum obtusifolium</i>	B
<i>var. japonica</i>	A	<i>Osmanthus ilicifolius</i>	B
<i>Morus bombycis</i>	B	<i>Trachelospermum asiaticum</i>	B
<i>Boehmeria spicata</i>	B	<i>Tylophora aristolochioides</i>	B
<i>Thalictrum minus</i>		<i>Callicarpa mollis</i>	B
<i>var. hypoleucum</i>	A	<i>Galium pogonanthum</i>	A
<i>Berberis thunbergii</i>	B	<i>Paederia scandens</i>	
<i>Cinnamomum japonicum</i>	B	<i>var. mairei</i>	B
<i>Lindera glauca</i>	B	<i>Abelia serrata</i>	A
L. <i>obtusiloba</i>	A	A. <i>spathulata</i>	B
<i>Sedum makinoi</i>	A	<i>Viburnum erosum</i>	B
<i>Deutzia crenata</i>	B	<b><i>Zabelia integrifolia</i></b>	A
D. <i>gracilis</i>	B	<i>Aster ageratoides</i>	
D. <i>scabra</i>	B	<i>ssp. amplexifolius</i>	B
<i>Hydrangea laetevirens</i>	B	<i>Carpesium divaricatum</i>	A
<i>Philadelphus satsumi</i>		<i>Picris hieracoides</i>	
<i>var. lancifolius</i>	B	<i>ssp. japonica</i>	B
<i>Kerria japonica</i>	B	<i>Youngia denticulata</i>	A
<i>Rubus hirsutus</i>	B	<i>Calamagrostis arundinacea</i>	
R. <i>palmatum</i>	B	<i>var. brachytricha</i>	A
<b><i>Spiraea nervosa</i></b>	A	<i>Miscanthus sinensis</i>	A
<i>Albizia julibrissin</i>	B	<i>Carex brunnea</i>	
<i>Lespedeza buergeri</i>	A B	<i>var. nakiri</i>	B
		C. <i>conica</i>	B

C. makinoensis	A B	Smilax china	B
Lilium maximowiczii	A	S. sieboldii	A B
Ophiopogon japonicus	B	Cymbium virescens	A

### 51. Oonogahara (Pref. Kochi, Pref. Ehime)

Oonogahara is an elusive undulating carst plateau of red soils extending to 1400m above sea level. Vegetationally it is represented by the vast *Miscanthus-Sasa* grassland, being intervened by the small woods of *Fagus crenata* and the artificial forests of *Larix leptolepis* or *Pinus densiflora* (TERAO 1953, YAMANAKA 1954 a). On the south flank of the plateau, on the other hand, limestone is fairly exposed to present some rocky slopes, where *Spiraea nervosa*, *Abelia spathulata*, *Lonicera ramosissima*, *Miscanthus sinensis* and *Carex sachalinensis* are predominating (YAMANAKA and MORISHITA 1956 b).

Depending upon YAMANAKA and MORISHITA (1956 b) and my own collections, the plants detectable in these and the neighbouring limestone fields are listed as below.

<b>Asplenium ruta-muraria</b>	A	Sedum aizoon	
(YAMANAKA 1954 a)		ssp. kamtschaticum	A B
<b>Camptosorus sibiricus</b>	A	Deutzia crenata	A
Cyrtomium fortunei	B	D. floribunda	B
Dennstaedtia wilfordii	A	D. gracilis	
Lemmaphyllum microphyllum	A	var. zentaroana	B
Polystichum craspedosorum	A	Hydrangea serrata	B
P. tsussimense		Philadelphus satsumi	B
var. mayebarai	B	Schizophragma hydrangeoides	A B
Cephalotaxus harringtonia	B	Malus sieboldii	
Chloranthus japonicus	A B	var. zumi	B
Salix sp.	B	Potentilla freyniana	B
Carpinus japonica	A B	Rubus palmatus	A B
C. tschonoskii	A	<b>Spiraea nervosa</b>	A
C. turczaninovii	B	Stephanandra incisa	B
Boehmeria spicata	A B	Vicia deflexa	
Asarum dimidiatum	C	var. minor	A
Euptelea polyandra	B	Wisteria brachybotrys	B
Aconitum loczyanum	B	Zanthoxylum piperitum	B
Anemone flaccida	B	Securinega suffruticosa	B
A. nikoensis	B	Rhus ambigua	A B
Clematis apiifolia	B	Euonymus alatus	
C. stans		f. striatus	A B
var. austro-japonensis	A	E. fortunei	
Paeonia japonica	B	var. villosus	A
Ranunculus japonicus	B	E. sieboldianus	B
Akebia trifoliata	B	Rhamnus japonica	
Berberis thunbergii	A B	var. microphylla	A
Epimedium grandiflorum	B	Viola grypoceras	A B
Lindera obtusiloba	A	V. patrinii	B
Corydalis decumbens	B	Alangium platanifolium	
Arabis flagellosa	A	var. trilobum	B

Chamaele decumbens	B	Eupatrium chinense	
Helwingia japonica	B	var. simplicifolium	B
Lithospermum zollingeri	B	Brachypodium sylvaticum	A
Glechoma hederacea		Hierochloe odorata	
ssp. grandis	B	var. pubescens	A
Galium kinuta	A B	Miscanthus sinensis	A B
G. pogonanthum		Sasa sp.	B
var. trichopetalum	A	Carex duvariana	A B
Abelia spathulata	A B	C. sachalinensis	
Lonicera ramosissima	A B	var. sikokiana	A
Viburnum erosum	A B	C. siderosticta	B
<b>Zabelia integrifolia</b>	A	Pinellia tripartita	B
Campanula punctata	A	Chionographis japonica	B
<b>Adenophora maximowicziana</b>	A B	Polygonatum odoratum	
Aster ageratoides		var. pluriflorum	B
ssp. amplexifolius	A B	Smilax sieboldii	B
A. scabra	B	Dioscorea septemloba	B

## KYUSHU

## 52. Hiraodai (Pref. Fukuoka)

Just south of Kokura, there develops a carst district named Hiraodai, about 10 square kilometers in area and 400m-600m in altitude. This plateau is composed of deep red soils from which lime contents are thoroughly leached out. Accordingly the vegetation is represented by the rather siliceous grassland. On the marginal regions of the plateau, however, we can often meet with cliffs or rubbly fields of limestone. Around the Senbutsu-do, for example, limestone is profiting the light forest with *Ficus erecta*, *Nandina domestica*, *Neolitsea sericea*, *Eriobotrya japonica*, *Zanthoxylum planispinum* and *Aucuba japonica* abundant. The following plants are all from the limestone field around Senbutsu-do. The rare species such as *Rhamnus yoshinoi* and *Viburnum calresii* var. *bitchuense*, though I could not find, must be also growing on limestone in other sites of the present district.

Cyclosorus acuminatus	B	Pittosporum tobira	B
Davallia mariesii	A	<b>Eriobotrya japonica</b>	A
Diplazium wichurae	A	Kerria japonica	B
Neocheiropteris ensata	A	Zanthoxylum piperitum	B
Phegopteris decursive-pinnata		Z. planispinum	B
Polystichopsis aristata	A	Acer palmatum	B
Pteris multifida	A	Parthenocissus tricuspidatus	B
Piper kadsura	A	Eurya japonica	B
Ficus erecta	A B	Viola grypoceras	A
F. nipponica	A	Elaeagnus pungens	B
Clematis terniflora	B	Hedera rhombea	A
Nandina domestica	B	Aucuba japonica	B
Menispermum dauricum	B	Ligustrum japonicum	B
Cinnamomum japonicum	B	Trachelospermum asiaticum	B
Neolitsea sericea	B	Damnacanthus indicus	B



Galium pogonanthum

A

Miscanthus sinensis

A B

## 53. Mt. Kawaradake (Pref. Fukuoka)

A little southward of the just preceding field, there occur three limestone peaks arranging south to north. These are Ichinotake, which was recently destroyed to be leveled for the cement industry, Ninotake and Sannotake of Mt. Kawaradake. Their altitudes are 492m, 460m and 508m, respectively. Anyway these are wholly constructed by limestone, and it can be found exposed mainly at upper elevation. There appear continuous rocky ridges. On the summit region of Ninotake, *Cephalotaxus harringtonia*, *Carpinus turczaninowii*, *Ficus erecta*, *Machilus thunbergii*, *Pittosporum tobira*, *Spiraea nervosa*, *Camellia japonica* and *Ligustrum japonicum* abundantly inhabit rocks of limestone. Also in Sannotake limestone is favoring these shrubous trees but *Spiraea* and *Carpinus*. The following plants are detectable at these rocky ridges.

Asplenium sarelii	A	Arabis flagellosa	A
<b>Camptosorus sibiricus</b>	A	Sedum makinoi	A
Cyrtomium falcatum	B	S. verticillatum	A
Davallia mariesii	A	Deutzia gracilis	
<b>Hypodematum fauriei</b>	A	var. zantaroana	A
Lemmaphyllum microphyllum	A	Philadelphus satsumi	A
Neocheropteris ensata	A	Schizophragma hydrangeoides	B
<b>Polystichum deltodon</b>	A	Pittosporum tobira	A
P. tsussimense	A B	Rubus parvifolius	B
Pyrrosia linearifolia	A	<b>Spiraea nervosa</b>	A
Selaginella tamariscina	A	Albizzia julibrissin	B
Podocarpus macrophylla	B	Caesalpinia japonica	B
Cephalotaxus harringtonia	B	Indigofera pseudotinctoria	B
<b>Carpinus turczaninowii</b>	A	Lespedeza cyrtobotrya	A
Quercus salicina	A	Wisteria brachybotrys	B
Celtis sinensis		Acalypha australis	B
var. japonica	B	Daphniphyllum sp.	B
Ficus erecta	B	Mallotus japonicus	B
F. stipulata	A	Ponciris trifoliata	B
Boehmeria nivea		Zanthoxylum piperitum	B
ssp. nipononivea	B	Z. planispinum	B
B. spicata	B	Rhus chinensis	A
Dianthus superbus		Ilex rotunda	B
ssp. longicalycinus	B	Euonymus alatus	
Clematis apiifolia	B	f. striatus	A
Thalictrum minus		E. fortunei	
var. hypoleucum	B	var. villosus	A
Akebia quinata	B	E. sieboldianus	A
Kadsura japonica	B	<b>Rhamnus yoshinoi</b>	A
Cinnamomum japonicum	B	Ampelopsis brevipedunculata	A
Some are shrublike with smaller leaves.		Parthenocissus tricuspidatus	A
Machilus thunbergii	B	Camellia japonica	B
Neolitsea sericea	B	Elaeagnus pungens	B
		Aralia cordata	B

Hedera rhombea	B	var. mairei	B
Bupleurum falcatum		Abelia spathulata	A
var. komarowi	B	<b>Viburnum carlesii</b>	
Pimpinella diversifolia	B	var. <b>bitchiuense</b>	A
Seseli ugoensis	B	<b>Zabelia integrifolia</b>	A
Aucuba japonica	B	Aster ageratoides	
Cornus macrophylla	B	ssp. leiophyllus	B
Ardisia japonica	B	Youngia denticulata	A
Fraxinus sieboldiana	B	Miscanthus sinensis	B
Ligustrum japonicum	A	Sasa sp.	B
Trachelospermum asiaticum	B	Carex brunnea	
Cynanchum atratum	B	var. nakiri	A
Callicarpa japonica	B	Pinellia tripartita	A
Clerodendron trichotomum	B	Hosta longipes	A
Clinopodium chinense		Lilium callosum	B
ssp. grandiflorum		Liriope platyphylla	B
var. parviflorum	B	Smilax china	B
Leonurus macranthus	B	Dioscorea tokoro	B
Galium pogonanthus	A	Belamcanda chinensis	A
Paederia scandens			

#### 54. Mt. Dodake (Pref. Miyazaki)

The summit region of Mt. Dodake (1200m elev.) is occupied by a huge prominent limestone bluff, more than 100m high. On the top of this bluff there is recognized in major part only a herbaceous cover on rock surface or in crevices. Its members are *Thalictrum actaeifolium*, *T. minus* var. *hypoleucum*, *Sedum aizoon* ssp. *kamtschaticum*, *Euphorbia sieboldiana*, *Angelica ubatakensis*, *Galium kinuta*, *Anaphalis sinica*, *Chrysanthemum zawadskii*, *Leontopodium japonicum* and so on. *Spiraea nervosa* and *Berberis tschonoskyana* are examples of few shrubous trees here. At the foot of the bluff on the other hand, where a rubbly slope extends along a stream, there develops a comparatively dense forest with *Euptelea polyandra*, *Orixa japonica*, *Acer carpiniifolium*, *Alangium platanifolium* var. *trilobum* and *Helwingia japonica* dominant. *Clematis speciosa* is a striking species on shady but rather dry gravelly sites. The following plants are all from this bluff or its surroundings, though *Bupleurum longiradiatum* f. *elatius* and *Tofieldia kiusiana* could not be detected by myself.

<b>Asplenium ruta-muraria</b>	A	Aconitum kiusianum	B
A. varians	A	<b>Clematis speciosa</b>	A B
<b>Camptosorus sibiricus</b>	A	Thalictrum actaeifolium	B
Cyrtomium fortunei	A	T. minus	
Polystichum craspedosorum	A	var. hypoleucum	A
Torreya nucifera	B	Dwarf plants with gland-dotted leaflets, corresponding with <i>T. yamamotoi</i> .	
Pinus pentaphylla			
var. himekomatsu	A		
Chloranthus serratus	B	Berberis tschonoskyana	B
Boehmeria spicata	A	Neolitsea sericea	B
Euptelea polyandra	B	Sedum aizoon	

ssp. <i>kamtschaticum</i>	A	<i>Isodon shikokianus</i>	
<i>Deutzia gracilis</i>		var. <i>intermedius</i>	B
var. <i>zentaroana</i>	A	<i>Lamium humile</i>	B
D. <i>scabra</i>	A	<i>Pedicularis resupinata</i>	A
<i>Philadelphus satsumi</i>	B	<i>Conandron ramondioides</i>	A
<i>Saxifraga cortusaefolia</i>	A	<i>Galium kinuta</i>	B
<i>Schizophragma hydrangeoides</i>	B	<i>Paederia scandens</i>	
<i>Kerria japonica</i>	A	var. <i>mairei</i>	A
<i>Potentilla dickinsii</i>	A	<i>Rubia chinensis</i>	
<b><i>Spiraea nervosa</i></b>	A	var. <i>glabrescens</i>	B
<i>Wisteria brachybotrys</i>	B	<i>Abelia spathulata</i>	A
<i>Orixa japonica</i>	B	<b><i>Anaphalis sinica</i></b>	A
<i>Euphorbia sieboldiana</i>	A	<i>Artemisia keiskeana</i>	A
<i>Rhus ambigua</i>	B	<i>Aster ageratoides</i>	
<i>Euonymus alatus</i>		ssp. <i>leiophyllus</i>	A
f. <i>striatus</i>	A B	<i>Chrysanthemum indicum</i>	A
<i>Acer carpinifolium</i>	B	<b>C. <i>zawadskii</i></b>	A
<i>Staphylea bumalda</i>	B	<i>Heteropappus hispidus</i>	A
<i>Diplomorpha yakushimensis</i>	A	<b><i>Leontopodium japonicum</i></b>	A
<i>Alangium platanifolium</i>		<i>Syneilesis palmata</i>	A B
var. <i>trilobum</i>	B	<i>Youngia denticulata</i>	A
<i>Hedera rhombea</i>	A	<i>Alectrurus yedoensis</i>	A
<i>Angelica ubatakensis</i>	A	<i>Allium thunbergii</i>	B
<b><i>Bupleurum longiradiatum</i></b>		<i>Hosta</i> sp.	A
f. <i>elatius</i>	?	<i>Lilium maximowiczii</i>	A
<i>Helwingia japonica</i>	B	<i>Polygonatum macranthum</i>	A
<i>Ligustrum tschonoskii</i>	B	<b><i>Tofieldia coccinea</i></b>	
<i>Swertia bimaculata</i>	B	var. <i>kiusiana</i>	?
<i>Trachelospermum asiaticum</i>	A	<i>Tricyrtis macropoda</i>	A

#### 55. Mt. Shiraiwa (Pref. Miyazaki)

Mt. Shiraiwa (1650m elev.) lies in Shiiba-mura of Higashi-usuki-gun, being close to the border line between prefectures of Miyazaki and Kumamoto. A little northward of the peak of this mountain, limestone is across the ridge which runs north to south. From here precipitous cliffs or rocky steep slopes fall into the valley on both sides of the ridge. As reported by HIRATA (1955), *Carpinus japonica* and *Fagus crenata*, wherever the forest is retainable, are dominant on the slope, whereas *Clematis stans* var. *austro-japonensis*, *Thalictrum actaeifolium*, *Sedum aizoon* ssp. *kamtschaticum*, *Spiraea nervosa*, *Bupleurum longiradiatum* f. *elatius*, *Galium kinuta*, *Anaphalis sinica*, *Chrysanthemum zawadskii*, *Leontopodium japonicum* and so on are flourishing on the open rocky places or in the rock crevices. It can be pointed out that the vegetation is much affined to that of the preceding mountain. In addition, it would be worth notice that some Ericaceous plants such as *Rhododendron kaempferi*, *R. metternichii* and *Tripetaleia paniculata* var. *latifolia* are crowded on a corner of this rocky ridge together with *Spiraea nervosa*. The vegetation of this kind is hardly seen so far as the limestone fields are concerned. The plants detected from the present field are as below.

<b>Asplenium ruta-muraria</b>	A	Potentilla dickinsii	A
<b>Camptosorus sibiricus</b>	A	Rosa sp.	B
Dryopteris polylepis	B	Spiraea japonica	
Polystichum craspedosorum	A	var. ovatifolia	A.
Woodsia polystichoides	A	<b>S. nervosa</b>	A
Taxus cuspidata	B	Euphorbia sieboldiana	B.
Picea polita	B	Euonymus alatus	
Pinus pentaphylla		f. striatus	A
var. himekomatsu	B	E. oxyphyllus	B.
Tsuga sieboldii	B	Rhamnus japonica	
<b>Juniperus sargentii</b>	A	var. microphylla	A.
Chloranthus serratus	A	Tilia japonica	B
Salix harmsiana	A	Daphne pseudomezereum	B
Pterocarya rhoifolia	B	Elaeagnus montana	B.
Carpinus japonica	B	<b>Bupleurum longiradiatum</b>	
Corylus sieboldiana	B	f. elatus	A B
Fagus crenata	A	Heracleum lanatum	B.
Quercus serrata	B	Cornus kousa	A
Trochodendron aralioides	B	Pyrola nephrophylla	B.
Aconitum kiushianum	B C	Enkianthus cernuus	B.
A. loczyanum	B	Rhododendron kaempferi	A
Cimicifuga acerina	B	R. metternichii	B.
<b>Clematis stans</b>		Tripetaleia paniculata	
var. austro-japonensis	A	var. latifolia	A B.
Paeonia japonica	B	Fraxinus sieboldiana	B.
Thalictrum actaeifolium	B	Swertia bimaculata	A B.
T. aquilegifolium		Comanthosphace barvinervis	B.
var. intermedium	B	Isodon shikokianus	
Thalictrum minus		var. intermedius	B.
var. hypoleucum	A	Melampyrum roseum	A
Some are much dwarfened corresponding with <i>T. yamamotoi</i> , while the other are of normal size. Leaflets somewhat with dotted glands in both forms.		Pedicularis resupinata	A B.
<b>Berberis amurensis</b>		Galium kinuta	B C.
var. bretschnideri	A	Rubia chinensis	
B. thunbergii	A B	var. glabrescens	B.
Lindera umbellata	A	Viburnum phlebotrichum	B.
Sedum aizoon		V. wrightii	
ssp. kamtschaticum	A	var. glandulosum	B.
Deutzia gracilis		Adenophora remotiflora	A B C
var. zentaroana	A	<b>Anaphalis sinica</b>	A
Philadelphus satsumi	A	Chrysanthemum indicum	A B.
Hamamelis japonica	B	<b>C. zawadskii</b>	A B.
Agrimonia pilosa	B	Cirsium suffultum	B C.
Aruncus dioicus		<b>Leontopodium japonicum</b>	A
var. tenuifolius	B	Picris hieracoides	
<b>Filipendula tsuguwoi</b>	B	ssp. japonica	A.
Kerria japonica	A B	Saussurea nipponica	
		ssp. kiusiana	C
		Carex chrysolepis	A
		C. siderosticta	B.
		Hosta nakaiana	A.

<i>Lilium maximowiczii</i>	A	<i>Epipactis papillosa</i>	B
<i>Veratrum maackii</i>	B		

### 56. Itsuki-mura (Pref. Kumamoto)

Several lodes of the Palaeozoic limestone are through the southern district of Pref. Kumamoto eastnortheast to westsouthwest. They result many limestone fields here and there in Gokanosho of Yatsushiro-gun and in the northern half of Kuma-gun. In this and the following two articles, I intend to describe the floras of some of them which were partly reported in my previous papers (1960).

In Itsuki-mura, the floristic research was done on the north side of Mt. Yatsuharu (300m to 1150 elev.) and the east side of Mt. Shiraga (500m to 1244m elev.).

(1) Around Mt. Yatsuharu—In Mt. Yatsuharu limestone is exposed at the lower and middle elevation. Especially around Takenokawa, northern foot of this mountain, there stand some prominent bluffs along the road on which *Ficus erecta*, *Deutzia gracilis* var. *zentaroana*, *Philadelphus satsumi* and *Spiraea nervosa* var. *latifolia* are fairly abundant. In the neighbourhood of Tsuzurase, middle side of the mountain, there occur gravelly stands on which *Clematis speciosa*, *Philadelphus satsumi*, *Kerria japonica*, *Alangium platanifolium* var. *trilobum* and *Aucuba japonica* compose comparatively dense bushes. The following plants are the members of these fields inclusively.

<i>Athyrium okuboanum</i>	B	ssp. <i>pseudopetiolaris</i>	B
A. <i>sheareri</i>	B	<i>Urtica thunbergiana</i>	B
A. <i>unifurcatum</i>	B	<i>Polygonum filiforme</i>	B
<i>Coniogramme intermedium</i>	B	<i>Clematis japonica</i>	B
<i>Cyrtomium falcatum</i>	B	<b>C. <i>speciosa</i></b>	A
C. <i>fortunei</i>	B	<i>Berberis thunbergii</i>	B
<i>Dryopteris atrata</i>	B	<b><i>Epimedium grandiflorum</i></b>	
<b><i>Hypodematium fauriei</i></b>	A	var. <i>higoense</i>	A
<i>Neochheiropteris ensata</i>	B	<i>Nandina domestica</i>	A
<i>Polypodium niponicum</i>	B	<i>Menispermum dauricum</i>	B
<i>Polystichum craspedosorum</i>	A	<i>Sinomenium acutum</i>	A B
P. <i>tsussimense</i>	A	<i>Kadsura japonica</i>	B
<i>Pteris cretica</i>	A	<i>Lindera glauca</i>	B
P. <i>multifida</i>	A B	<i>Sedum viride</i>	A
<i>Woodwardia orientalis</i>	B	<i>Deutzia gracilis</i>	
<i>Torreya nucifera</i>	B	var. <i>zentaroana</i>	A B
<i>Cephalotaxus harringtonia</i>	A	<i>Philadelphus satsumi</i>	A B
<i>Cryptomeria japonica</i>	B	<i>Kerria japonica</i>	B
Planted,		<i>Rosa multiflora</i>	B
<i>Quercus glauca</i>	B	<i>Rubus buergeri</i>	B
<i>Brousenettia kazinoki</i>	A	<b><i>Spiraea nervosa</i></b>	
<i>Ficus erecta</i>	A	var. <i>latifolia</i>	A
<i>Pilea japonica</i>	A	<i>Albizia julibrissin</i>	A
P. <i>petiolaris</i>		<i>Lespedeza buergeri</i>	A

<i>Euphorbia sieboldiana</i>	A	<i>Strobilanthes oligantha</i>	B
<i>Mercurialis leiocarpa</i>	B	<i>Galium pogonanthum</i>	A
<i>Securinega suffruticosa</i>	A	<i>Aster fastigiatus</i>	B
<i>Euonymus alatus</i>		<i>Chrysanthemum indicum</i>	A B
<i>f. striatus</i>	A	<i>Erigeron annuus</i>	
<i>Actinidia polygama</i>	B	<i>rar. laevis</i>	B
<i>Camellia japonica</i>	B	<i>Pertya robusta</i>	B
<i>Xylosma japonica</i>	A	<i>Arundinella hirta</i>	B
<i>Stachyurus praecox</i>	B	<i>Brachypodium sylvaticum</i>	A
<i>Alangium platanifolium</i>		<i>Calamagrostis arundinacea</i>	
<i>var. trilobum</i>	B	<i>var. brachytricha</i>	A
<i>Hedera rhombea</i>	A	<i>Oplismenus undulatifolius</i>	B
<i>Angelica shikokiana</i>	A	<i>Phyllostachys heterocycla</i>	
<i>Cryptotaenia canadensis</i>		<i>var. pubescens</i>	B
<i>ssp. japonica</i>	B	<i>Carex sp.</i>	A
<i>Aucuba japonica</i>	B	<i>Trachycarpus fortunei</i>	B
<i>Swertia sertopsis</i>	B	<i>Pinellia tripartita</i>	A
<i>Solanum lyratum</i>	B	<i>Allium tuberosum</i>	A
<i>Dicliptera japonica</i>		<i>Liriope platyphylla</i>	B
<i>var. subrotundata</i>	B		

(2) Around Mt. Shiraga—In this mountain I took a route from Kozuru through Iboshi to the middle elevation. At Kozuru, western foot of this mountain, there vertically stands a series of huge limestone cliffs over the valley. Here, *Quercus glauca*, *Zelkova serrata*, *Neolitsea sericea*, *Platycrater arguta*, *Zanthoxylum planispinum*, *Acer carpinifolium* and *Aucuba japonica* are abundant trees or shrubs, while *Hypodematium fauriei*, *Polystichum deltodon*, *Clematis speciosa*, *Spiraea nervosa*, *Hosta longipes* and *Lilium maximowiczii f. tenuifolium* are attractively colonized on the surface of the bluff here and there. Around a large cliff upward of Iboshi, on the other hand, *Neolitsea sericea*, *Parabenzoin praecox*, *Hydrangea luteovenosa*, *H. serrata*, *Kerria japonica*, *Orixa japonica*, *Acer carpinifolium*, *A. palmatum* and *Alangium platanifolium var. trilobum* are flourishing to be dense woods or bushes, while there are sporadically found *Cyrtomium fortunei*, *Boehmeria spicata*, *Sedum verticillatum*, *Deutzia gracilis var. zentaroana*, *Saxifraga cortusaefolia*, *Mercurialis leiocarpa*, etc. on surface of the bluff. These members are inclusively listed below.

<i>Asplenium varians</i>	A	<i>P. tripterum</i>	B
<b>Camptosorus sibiricus</b>	A	<i>P. tsussimense</i>	A
<i>Coniogramme intermedium</i>	B	<i>Pteris cretica</i>	A
<i>Cyrtomium falcatum</i>	A	<i>Torreya nucifera</i>	B
<i>C. fortunei</i>	A B	<i>Cephalotaxus harringtonia</i>	B
<i>Dryopteris lacera</i>	A	<i>Quercus glauca</i>	B
<b>Hypodematium fauriei</b>	A	<i>Q. myrsinaefolia</i>	A
<i>Lemmaphyllum microphyllum</i>	A	<i>Zelkova serrata</i>	A
<i>Neocheiropteris subhastata</i>	A	<i>Ficus erecta</i>	A
<i>Polystichum craspedosorum</i>	A	<i>F. nipponica</i>	A
<b>P. deltodon</b>	A	<i>Boehmeria nivea</i>	

ssp. nipononivea	B	A. cissifolium	B
B. spicata	A	A. palmatum	B
Pilea peploides	B	Ampelopsis brevipedunculata	B
P. petiolaris		Actinidia polygama	B
ssp. pseudopetiolaris	B	Daphne pseudomezereum	B
Urtica thunbergiana	B	Elaeagnus pungens	A
Clematis japonica	A B	Alangium platanifolium	
C. speciosa	A	var. trilobum	B
Paeconia obovata	A B	Hedera rhombea	A
Berberis thunbergii	A	Angelica shikokiana	A
Sinomenium acutum	B	Aucuba japonica	B
Machilus japonica	A	Helwingia japonica	B
Neolitsea sericea	B	Ligustrum ibota	B
Parabenzoin trilobum	B	L. tschonokii	A
P. praecox	B	Marsdenia tomentosa	B
Arabis flagellosa	A	Tylophora floribunda	B
A. serrata		Ancystrocarya japonica	A
var. shikokiana	A	Tubocapsicum anomalum	B
Sedum makinoi	A	Botryopleuron axillare	B
S. verticillatum	A	Dicliptera japonica	B
S. viride	A	Galium pogonanthum	A
Deinanthe bifida	B	G. trifloriforme	A
Deutzia gracilis		Ophiorrhiza japonica	A
var. zentaroana	A	Lonicera gracilipes	A
Hydrangea luteovenosa	B	Sambucus sieboldii	A
H. serrata	B	Trichosanthes cucumeroides	B
Philadelphus satsumi	A	Aster fastigiatus	A
Platycrater arguta	A	Cirsium lucens	B
Saxifraga cortusaefolia	A	C. suffultum	B
Schizophragma hydrangeoides	B	Erechitites hieracifolia	B
Distylium racemosum	A	Ligularia stenocephala	B
Kerria japonica	A B	Brachypodium sylvaticum	A
Rubus buergeri	B	Plants densely pubescent.	
<b>Spiraea nervosa</b>	A	Melica onoei	A
Lespedeza buergeri	A	Carex brunnea	
Orixa japonica	A	var. nakiri	A
Zanthoxylum piperitum	A	Pinellia tripartita	A
Z. planispinum	A	Hosta longipes	A
Picrasma quassioides	A	Lilium maximowiczii	
Mercurialis leiocarpa	A	f. tenuifolium	A
Euonymus fortunei		Liriope platyphylla	A
var. radicans	A	Smilax oldhami	A
E. oxyphyllus	A	Dioscorea asclepiadea	B
Acer carpinifolium	A B	Calanthe reflexa	B

### 57. Mt. Noke-eboshi (Pref. Kumamoto)

Mt. Noke-eboshi (1302m elev.) lies over Itsuki-mura, Youra-mura and Yamae-mura of Kuma-gun. As it is also located on the limestone formation, there occur in some parts prominent bluffs such as Tenguiwa and Hotokeishi,

and in other parts gravelly slopes. It can be roughly stated that the vegetation is represented by the deciduous lower forest the dominant plants of which are *Cyrtomium fortunei*, *Polystichum tripterum*, *Cimicifuga acerina*, *C. simplex*, *Orixa japonica*, *Acer carpinifolium* and *Alangium platanifolium* var. *trilobum* on the gravelly sites, and is characterized by *Clematis speciosa*, *Sedum aizoon* ssp. *kamtschaticum*, *Platycrater arguta*, *Spiraea nervosa*, *Angelica shikokiana*, *Zabelia integrifolia*, *Veratrum maackii*, etc. on occasional cliffs. All the plants detected from these fields are as below.

<i>Asplenium varians</i>	A	ssp. <i>pseudopetiolaris</i>	B
<i>Athyrium mesosorum</i>	B	<i>Urtica thunbergiana</i>	B
A. <i>okuboanum</i>	B	<i>Cimicifuga acerina</i>	B
A. <i>pycnosorum</i>	B	<i>C. simplex</i>	B
<b>Camptosorus sibiricus</b>	A	<i>Clematis japonica</i>	A
<i>Cyrtomium fortunei</i>	B	<i>C. speciosa</i>	A
<i>C. macrophyllum</i>	B	<i>C. stans</i>	
<i>Dennstaedtia wilfordii</i>	B	var. <i>austro-japonensis</i>	A
<i>Dryopteris tashiroi</i>	B	<i>Thalictrum actaeifolium</i>	A
<i>Neocheiropteris ensata</i>	B	<i>T. minus</i>	
<i>Onychium japonicum</i>	A	var. <i>hypoleucum</i>	A
<i>Polystichum craspedosorum</i>	A	<i>Berberis thunbergii</i>	A
P. <i>retroso-paleaceum</i>		<b>Epimedium grandiflorum</b>	
var. <i>ovato-paleaceum</i>	B	var. <i>higoense</i>	A
P. <i>tripteron</i>	B	<i>Nandina domestica</i>	B
<i>Pteris cretica</i>		<i>Lindera obtusiloba</i>	B
var. <i>albo-lineata</i>	A	<i>Neolitsea sericea</i>	B
<i>Selaginella involvens</i>	A	<i>Arabis serrata</i>	
<i>Torreyia nucifera</i>	B	var. <i>shikokiana</i>	A
<i>Cephalotaxus harringtonia</i>	B	<i>Sedum aizoon</i>	
<i>Pinus densiflora</i>	A	ssp. <i>kamtschaticum</i>	A
<i>Tsuga sieboldii</i>	A B	<i>Astilbe thunbergii</i>	A
<b>Juniperus sargentii</b>	A	<i>Chrysosplenium macrostemon</i>	B
<i>Chloranthus japonicus</i>	A	<i>Deinathe bifida</i>	B
<i>Carpinus japonica</i>	A	<i>Deutzia gracilis</i>	
Leaves small, 2~5 cm long.		var. <i>zentaroana</i>	A
C. <i>tschonokii</i>	A	<i>Hydrangea serrata</i>	A
Shrubs with small leaves not extending to 3.5 cm long. Lateral veins 10 or so paired.		<i>Philadelphus satsumi</i>	A
<i>Quercus gilva</i>	B	<i>Platycrater arguta</i>	A B
Q. <i>glauca</i>	B	<i>Aruncus dioicus</i>	
Q. <i>mongolica</i>		var. <i>tenuifolius</i>	A
var. <i>grosseserrata</i>	A B	<i>Geum japonicum</i>	B
Q. <i>salicina</i>	B	<i>Potentilla cryptotaeniae</i>	B
<i>Zelkova serrata</i>	A	P. <i>dickinsii</i>	A
<i>Ficus stipulata</i>	A	<i>Rosa multiflora</i>	B
<i>Boehmeria spicata</i>	A B	<b>Spiraea nervosa</b>	A
<i>Pilea japonica</i>	B	<i>Lespedeza buergeri</i>	A
P. <i>petiolaris</i>		L. <b>homoloba</b>	
		var. <i>higoensis</i> , var. nov.	A
		<i>Orixa japonica</i>	B



Zanthoxylum piperitum	A	Melampyrum roseum	A B
Z. planispinum	A	Pedicularis resupinata	A
Polygala japonica	A	Conandron ramondioides	A
Euphorbia sieboldiana	B	Galium pogonanthum	A
Daphniphyllum macropodum	B	Hedyotis lindleyana	
Securinega suffruticosa	B	var. hirsuta	B
Sapium japonicum	A B	Rubia chinensis	
Ilex pedunculosa	B	var. glabrescens	B
Euonymus alatus		R. cordifolia	
f. striatus	A B	var. munjista	A
E. oxyphyllum	B	Paederia scandens	
Staphylea bumalda	B	var. mairei	A
Acer carpiniifolium	B	Abelia serrata	A
A. mono	A	Lonicera japonica	B
A. palmatum	B	Viburnum erosum	B
<b>Rhamnus yoshinoi</b>	A	<b>Zabelia integrifolia</b>	A
Actinidia polygama	B	Adenophora remotiflora	A
Viola ovato-oblonga	A	Artemisia keiskeana	
Diplomorpha yakusimensis	A	Cacalia delphiniifolia	B
Elaeagnus pungens	A	Carpesium koidzumii	B
Alangium platanifolium		Chrysanthemum indicum	B
var. trilobum	B	C. <b>zawadskii</b>	A
Acanthopanax divaricatus	A	Diaspanthus uniflorus	B
A. <b>hypoleucus</b>	A	Brachypodium sylvaticum	A
Hedera rhombea	A	Calamagrostis arundinacea	
<b>Angelica shikokiana</b>		var. brachytricha	A
var. <b>mayebarana</b>	A	Diarrhena japonica	B
var. shikokiana	A	Muhlenbergia hakonensis	A
Spuriopimpinella calycina	B	Orthoraphium coreanum	
S. nikoensis	B	var. kengii	A
Cornus kousa	B	Sasa sp.	B
Helwingia japonica	B	Spodiopogon sibiricus	A
Styrax japonica	B	Pinellia tripartita	A
Fraxinus lanuginosa		Pollia japonica	B
var. serrata	A	Chionographis japonica	A
F. spaethiana	B	Very small plants.	
Ligustrum tschonoskii	B	Hosta longipes	A
Swertia swertopsis	B	Lilium cordatum	B
Cynanchum grandifolium	A	L. maximowiczii	
Chelonopsis moschata	B	f. tenuifolium	A
Keiskea japonica	A B	Veratrum maackii	A
Solanum japonense	B	Dioscorea tenuipes	B

### 58. Konose-mura (Pref. Kumamoto)

The same limestone lodes, which presented us many good fields in the previous districts, are also continuously across Konose-mura and offer some cliff regions at about 100m or so in altitude along the Kuma-river in particular. In this article I describe the flora of the cliff regions en route from Konose to Osakama inclusively, where we can see some precipitous cliffs

overhanging the river such as Yaritaoshinose and Seishokonoiwa. On the whole, these cliffs are of dry condition. Among the members of the poor vegetation covering sunny surfaces of these cliffs, *Ficus erecta*, *Spiraea nervosa*, *Angelica shikokiana* var. *mayebarana* and *Miscanthus sinensis* are very striking in abundance. The plants detected are as below.

<i>Asplenium sarelii</i>	A	<b>Eriobotrya japonica</b>	A
<i>Cyrtomium falcatum</i>	A	<i>Rosa multiflora</i>	A B
C. fortunei	A B	<b>Spiraea nervosa</b>	A
<i>Diplazium wichurae</i>	A	<i>Indigofera pseudotinctoria</i>	A
<i>Equisetum ramosissimum</i>		<i>Oxalis corniculata</i>	
var. japonicum	A	var. erecta	A
<i>Neocheiropteris ensata</i>	A B	<i>Zanthoxylum planispinum</i>	B
<i>Lemmaphyllum microphyllum</i>	A	<i>Mallotus japonicus</i>	B
<i>Onychium japonicum</i>	A	<i>Mercurialis leiocarpa</i>	B
<i>Polystichopsis pseudoaristata</i>	D	<i>Securinega suffruticosa</i>	A
<b>Polystichum deltodon</b>	A	<b>Buxus microphylla</b>	
P. tsussimense	A	var. japonica	A
<i>Pteris cretica</i>	A	Near to var. <i>insularis</i> in its leaf texture.	
<b>P. deltodon</b>	A	<i>Rhus chinensis</i>	A
P. multifida	A	<i>Euonymus alatus</i>	
<i>Selaginella involvens</i>	A	f. striatus	A B
S. tamariscina	A	E. japonicus	A
<i>Woodsia polystichoides</i>	A	E. sieboldianus	B
<i>Piper kadzura</i>	A	<i>Parthenocissus tricuspidatus</i>	A
<i>Quercus glauca</i>	B	<i>Xylosma japonicum</i>	A
Q. salicina	A	<i>Elaeagnus pungens</i>	A
<i>Celtis sinensis</i>		<b>Angelica shikokiana</b>	
var. japonica	B	var. <i>mayebarana</i>	A
<i>Ficus erecta</i>		<i>Cornus controversa</i>	B
var. sieboldii	A	<i>Ardisia pusila</i>	A
F. stipulata	A	<i>Ligustrum japonicum</i>	A
<i>Boehmeria nivea</i>		<i>Trachelospermum asiaticum</i>	A
ssp. nipononivea	B	<i>Strobilanthes oligantha</i>	B
<i>Elatostemma laetevirens</i>	A	<i>Galium pogonanthum</i>	A
<i>Pilea mongolica</i>	A	<i>Ophiorrhiza japonica</i>	A
P. petiolaris		<i>Weigela japonica</i>	A
ssp. pseudopetiolaris	B C	<i>Artemisia princeps</i>	B
<i>Villebrunea frutescens</i>	B	<i>Erechtithes hieracifolia</i>	A
<i>Nandina domestica</i>	B	<i>Youngia denticulata</i>	B
<i>Neolitsea sericea</i>	B	<i>Melica onoei</i>	A
<i>Arabis flagellosa</i>	A	<i>Miscanthus sinensis</i>	A
<i>Sedum makinoi</i>	A	<i>Setaria viridis</i>	A
<i>Deutzia gracilis</i>		<i>Carex</i> sp.	A
var. zentaroana	A	<i>Pinellia tripartita</i>	A B
D. scabra	A	<i>Liriope platyphylla</i>	B
<i>Philadelphus satsumi</i>		<i>Smilax oldhami</i>	B
var. lancifolius	B	<i>Dioscorea septemloba</i>	B
var. satsumi	A	D. tokoro	B
<i>Saxifraga cortusaefolia</i>	A		

Belamcanda chinensis A

In addition, I could collect the following plants from exposed limestone at the roadside near Otsuki (400m alt.) about 8km northeast of the above district.

<b>Camptherosorus sibiricus</b>	A	Z. schinifolium	A
Cyrtomium fortunei	A	Rhus chinensis	A
Dryopteris uniformis	A	Euonymus alatus	
Lemmaphyllum microphyllum	A	f. striatus	A
Polystichum craspedosorum	A	Parthenocissus tricuspidatus	A
P. tsussimense	A	Stachyurus praecox	A
Quercus salicina	A	Elaeagnus pungens	A
Boehmeria spicata	A	<b>Angelica shikokiana</b>	
<b>Clematis speciosa</b>	A	var. <b>mayebarana</b>	A
Deutzia gracilis		Aucuba japonica	B
var. zentaroana	A	Ligustrum tschonokii	A
Philadelphus satsumi	A	Weigela japonica	A
Platycrater arguta	A	Youngia denticulata	A
Saxifraga fortunei		Y. japonica	A
var. incisolobata	A	Pinellia tripartita	A
Kerria japonica	A	Liriope platyphylla	A
Orixa japonica	B	Belamcanda chinensis	A
Zanthoxylum piperitum	A		

#### 59. Mt. Ryuho (Pref. Kumamoto)

Mt. Ryuho (517m elev.), east of Yatsushiro, is about 10km far from the coast of the Yatsushiro-bay. Over than 300m in elevation limestone occurs here and there, forming rocky ridges particularly on the summit region. *Quercus glauca* and *Cinnamomum japonicum* are pretty abundant there. *Nandina domestica* and *Euonymus alatus* f. *striatus* are the important members of the shrub layer, while *Cyrtomium falcatum*, *Pyrrosia lingua* and *P. tricuspis* are often met with on bared rocks. The plants detected are as below.

Cyrtomium falcatum	A	Cinnamomum japonicum	B
Dryopteris erythrosora	A	Machilus thunbergii	B
Polystichum tsussimense	A	Neolitsea sericea	B
Pteris cretica	A	Berchemia magna	B
Pyrrosia linearifolia	A	Daphne kiusiana	B
P. lingua	A	Elaeagnus pungens	B
P. tricuspis	A	Alangium platanifolium	
Cephalotaxus harringtonia	B	var. trilobum	B
Quercus glauca	B	Aucuba japonica	B
Q. salicina	B	Cornus kousa	B
Celtis sinensis		Helwingia japonica	B
var. japonica	B	Diospyros kaki	
Ficus erecta	A	var. sylvestris	B
F. stipulata	A	Ligustrum japonicum	B
Boehmeria spicata	A	Trachelospermum asiaticum	A
Pilea mongolica	A	Tylophora aristolochioides	
Nandina domestica	B	Galium pogonathum	A

Arundinella hirsuta	A	var. nakiri	A
Miscanthus sinensis	A B	Liriope platyphylla	B
Carex brunnea		Smilax oldhami	A

## TAIWAN\*

## 60. Mt. Chingshui (Pref. Hualien)

Mt. Chingshui (ca. 2400m elev.), situated at the north-eastern corner of Pref. Hualien, is rich in inapproachable enormous precipices of limestone. Apart from these helpless precipices, we were mainly concerned with screes or rubbly fields which occurred everywhere in the middle and upper part of this mountain. Although still I cannot propose the precise description of its vegetation throughout, some examples of vegetational sketches are as follows.

Shrubbery at the gravelly ridges: This is the light low forest composed of various shrubs and trees such as *Berberis aristatoserrata*, *Pittosporum oligocarpum*, *Pourthiaea chingshuiensis*, *Rhaphiolepis impressivena*, *Vaccinium wrightii*, *Maesa tenera*, *Ligustrum japonicum* var. *pubescens*, *L. morrisonense*, *Abelia chinensis*, *Viburnum propinquum*, etc. Such vegetation is observable at rather low altitude of 1000m or so.

Grassland at the open gravelly ridges: The vegetation is never dense. But, *Thalictrum urbaini*, *Potentilla morii*, *Artemisia somai* var. *batakensis*, *Chrysanthemum morii*, *Aletris spicata*, *Lilium philippinense* var. *formosanum*, etc. are striking. In crevices in rocks, there grow *Asplenium pulcherrima*, *A. ruta-muraria*, *Parnassia palustris*, *Galium gracilens*, *G. tarokoense*, *Justicia procumbens*, *Carex daiyuensis*, etc. Sometimes, *Juniperus formosana* var. *concolor* is dotted. Such vegetation is often observable at upper elevation.

Vacant rocky slope: The vegetation is negligible. *Pinus taiwanensis*, *Clematis psilandra*, *Rhamnus oiwakensis*, *Geranium robertianum*, etc. sporadically colonize on the rocky slope. I met with such field at about 2000m alt.

All the plants detected from these fields are as below.

Antrophyum formosanum	A	Dicranopteris dichotoma	B
A. obovatum	A	Diplazium dilatatum	B
?Asplenium exiguum	A	Dryopteris eatoni	A B
A. normale	A	D. formosana	B
A. <b>pulcherrimum</b>	A	D. sordidipes	B
A. ritoense	A	Elaphoglossum callifolium	A
A. <b>ruta-muraria</b>	A	Humata griffithianum	A
A. trichomanes	B	Lepisorus kawakamii	B
Cheiropleuria bicuspis	A	Lindsaea terera	
Cyclosorus taiwanensis	B	var. chienii	B
<b>Cyrtogonellum fraxinellum</b>	A	Lycopodium sp.	A
<b>Cyrtomium caryotideum</b>	A	Microsorium buergerianum	A
C. falcatum	B	Plagiogyria sp.	B

\* I am indebted to the Ministry of Education of China for the financial aid for the present study. Also, it is supported by the Grant in Aid of Scientific Research of the Ministry of Education of Japan.

Polystichopsis aristata	A B	Pittosporum oligocarpum	B
Polystichum hancockii	A B	<b>Corylopsis matsudai</b>	B
Pteridium sp.	B	Distylium gracile	B
<b>Pteris deltoodon</b>	A B	Cotoneaster morrisonensis	B
P. dispar	A	Eriobotrya deflexa	B
Selaginella delicatula	A	Photinia serrulata	B
S. sp.	A	Potentilla morii	A B
Thelypteris angustifrons	B	<b>Pourthiaea chingshuiensis</b>	B
Podocarpus philippinensis	B	Prunus phaseosticta	B
Pinus morrisonicola	A B	<b>Raphiolepis impressivena</b>	B
P. taiwanensis	A	Rubus calycinoides	A
Tsuga chinensis	B	Bauhinia championi	A
Chamaecyparis formosensis	B	<b>Geranium robertianum</b>	B
<b>Juniperus formosana</b>	A B	Boenninghausenia albiflora	A
<b>J. sargentii</b>	A	Skimmia reevesiana	B
Peperomia dindygulensis	A	Zanthoxylum cuspidatum	A
Salix taiwanalpina	B	Hiptage bengalensis	B
Platycarya strobilacea	B	Polygala japonica	B
Carpinus kawakamii	B	Glochidion fortunei	B
C. rankanensis	B	Mercurialis leiocarpa	B
Quercus spinosa		<b>Buxus microphylla</b>	
var. miyabei	B	var. <b>sinica</b>	B
Quercus sp. (three species)	B	Rhus succedanea	B
Pilea brevicornuta	A	Ilex kanehirai	B
P. peploides	A	I. lonicerifolia	A
Asarum leptophyllum	B	Microtropis ilicifolia	B
Heterotropa infrapurpurea	B	Perrottetia arisanensis	B
<b>Cerastium kaorii</b> , sp. nov.	A	Acer oblongum	B
Stellaria arisanensis		Berchemia lineata	A B
var. leptophylla	A	B. racemosa	B
Trochodendron aralioides	B	<b>Rhamnus chingshuiensis</b> , sp. nov.	B
<b>Clematis psilandra</b>	B	<b>R. oiwakensis</b>	A B
<b>Thalictrum urbaini</b>		Sageretia theezans	B
var. <b>majus</b> , var. nov.	A	Cleyera morii	B
Berberis aristato-serrata	A B	Ternstroemia gymnanthera	B
<b>B. chingshuiensis</b> , sp. nov.	A B	<b>Takasagoya geminiflora</b>	B
Lindera sp.	B	<b>T. nakamurai</b>	B
Litsea dolichocarpa	B	Viola kawakamii	A
Arabis alpina	A B	V. longistipulata	A B
Flowers large and pinkish.		Stachyurus himalaicus	B
Sedum actinocarpum	A	Daphne taiwaniana	A B
S. arisanense	A	Elaeagnus morrisonensis	B
Astilbe longicarpa	B	Blastus cochinchinensis	B
Deutzia pulchra	B	Bredia oldhami	B
D. taiwanensis	A	<b>Angelica tarokoensis</b>	A
Hydrangea longifolia	B	Hydrocotyle javanica	B
H. macrosepala	A B	Pimpinella niitakayamensis	A
Parnassia palustris	A	Helwingia formosana	B
Schizophragme integrifolia		Pyrola morrisonensis	B
var. fauriei	B	Rhododendron breviperulatum	B

R.	leiopodum	B	Anaphalis margaritacea	
R.	rubropilosum	B	ssp. morrisonicola	A
Vaccinium	emarginatum	B	<b>Artemisia somai</b>	
V.	wrightii	B	var. <b>batakensis</b>	A
Ardisia	pusilla		Aster twiwanensis	A
	f. liukuensis	B	<b>Chrysanthemum morii</b>	A
Maesa	tenera	B	Cirsium suzukii	B
Myrsine	seguinii	B	Erigeron fukuyamae	A
Lysimachia	capillipes	B	Eupatium shimadae	A
Symplocos	modesta	B	Farfugium japonicum	
Ligustrum	japonicum		var. formosanum	A
	var. pubescens	B	Ixeris laevigata	
L.	morrisonense	B	var. oldhami	A B
L.	seisuiense	B	Arundinella pubescens	A
<b>Gentiana kaorii</b> , sp. nov.		B	Oplismenus compositus	B
Tripterospermum	japonicum	B	Carex daibuensis	A B
Anodendron	benthamianum	B	C. fulvorubescens	A
Tylophora	oshimae	B	C. morii	B
Trigonotis	formosana	B	C. sociata	A
Perilla	shimadae	B	Arisaema heterophyllum	B
Salvia	keitaoensis	A	A. taihokensis	A B
	Inflorescence with dense glandular hairs.		Aletris spicata	A
			Dianella ensifolia	A
<b>Scutellaria procumbens</b>		A	Lilium philippinense	
<b>Euphrasia tarokoana</b>		A B	var. formosanum	A
Titanotrichum	oldhami	A	Ophiopogon formosana	B
Justicia	procumbens		Paris lancifolia	A B
	var. hirsuta	A	Polygonatum arisanense	A
Strobilanthus	rankanensis	B	<b>Smilax elongato-reticulata</b>	A B
Damnacanthus	formosanum	A	S. lanceaefolia	
Galium	garcilens	A	var. opaca	B
G.	minutissimum, sp. nov.	A	S. oxyphylla	B
Psychotria	rubra	B	Tricyrtis suzukii	B C
Rubia	cordifolia		Veratrum formosanum	B
	var. munjista	B	Dioscorea colletii	A
Rubia	lacneolata	B	Bletilla formosana	B
<b>Abelia chinensis</b>		A B	Calanthe sp.	B
Viburnum	formosanum	B	Cephalanthera alpicola	B
V.	propinquum	A B	Cypripedium taiwanianum	B
V.	sp.	B	Herminium angustifolium	A
<b>Patrinia glabrifolia</b>		B	Microstylis sp.	B
Gymnostemma	pentaphyllum	B	?Platanthera stenoglossa	A
Ainsliaea	fragrans	B	Poneorchis taiwanensis	A B
A.	macrocrinidioides	B	?Tainia sp.	B

#### 61. Chingshui to Chongde (Pref. Hualien)

The route from Chingshui to Chongde, 100m or so elev., is along the coast and below the almost continuous limestone walls. Regardless to surface of the cliffs, the mountain slopes which fall into the occasional valleys and

are covered with deep soils are occupied by the secondary forests comprising of some tree ferns, *Tremma orientalis*, *Laportea pterostigma*, *Macaranga tanarius*, *Bischoffia javanica*, etc. and by the dense covers comprising of *Angiopteris lygodiifolia*, *Arenga engleri*, *Calamus margaritacea*, *Alocassia macrorrhiza*, etc. Both on the gravelly places and on the cliffs, however, the vegetation is extremely poor. *Juniperus formosana* var. *concolor*, some fig trees, *Rosa taiwanensis*, *Sageretia theezans*, *Leucas mollissima* var. *chinensis*, *Chrysanthemum morii*, *Heteropappus hispidus*, *Ixeris laevigata* var. *oldhami*, *Asparagus lucidus*, *Smilax elongato-reticulata*, etc. are fairly abundant on these fields. All the detected plants are as below.

<i>Adiantum capillis-veneris</i>	A	<i>Tetrastigma erubescens</i>	A
<i>Aleuritopteris argentea</i>	A	<i>Stachyurus himalaicus</i>	B
<i>Antrophyum formosanum</i>	A	<i>Ardisia pusilla</i>	
A. sp.	A	f. <i>liukiensis</i>	A
<i>Dryopteris eatoni</i>	A	<i>Lysimachia decurrens</i>	B
<b>Hypodematium crenatum</b>	A	<i>Fraxinus insularis</i>	A
<i>Lygodium japonicum</i>	A	<i>Anodendron benthamianum</i>	A
<i>Psilotum nudum</i>	A	<i>Ehretia dicksonii</i>	B
<i>Selaginella delicatula</i>	A	<i>Thyrocarpus sampsonii</i>	A
S. <i>tamariscina</i>	A	<i>Leucas mollissima</i>	
S. sp.	A	var. <i>chinensis</i>	A B
<b>Juniperus formosana</b>	A	<i>Salvia keitaoensis</i>	A
<i>Peperomia reflexa</i>	A	<i>Justicia procumbens</i>	
<i>Chloranthus oldhami</i>	B	var. <i>leucantha</i>	A
<i>Ficus retusa</i>	B	<b>Hayataella michelloides</b>	A
F. <i>tinctoria</i>	A B	<i>Ophiorrhiza japonica</i>	
F. <i>vaccinioides</i>	A	var. <i>acutiloba</i>	A
<i>Morus australis</i>	A	<i>Viburnum</i> sp.	A
<i>Pilea peploides</i>	A	<i>Aster taiwanensis</i>	A
<i>Asarum leptophyllum</i>	C	<i>Blumea laciniata</i>	A
<i>Cassytha filiformis</i>	A	<b>Chrysanthemum morii</b>	A
<i>Deutzia taiwanensis</i>	A	<i>Emilia sonchifolia</i>	A
<i>Pittosporum tobira</i>	A	<i>Eupatium amabile</i>	A
<i>Rosa taiwanensis</i>	A	<i>Heteropappus hispidus</i>	A
Calyx tubes and sepals outside glabrous. Plant with few glandular hairs.		<i>Ixeris laevigata</i>	
<i>Campylotropis giraldii</i>	B	var. <i>oldhami</i>	A
<i>Canavalis maritima</i>	B	<i>Sonchus arvensis</i>	A
<i>Cassia occidentalis</i>	B	<i>Pothos seemanni</i>	A
<i>Zanthoxylum cuspidatum</i>	A	<i>Asparagus lucidus</i>	A B
<i>Ilex asprella</i>	A	<i>Dianella ensifolia</i>	A
<i>Acer oblongum</i>	B	<i>Lilium philippinense</i>	
<i>Dodonaea viscosa</i>	A	var. <i>formosanum</i>	A
<i>Sageretia theezans</i>	A	<b>Smilax elongato-reticulata</b>	A B
		<i>Bletilla formosana</i>	A

## 62. Tailuko (Pref. Hualien)

The famous landscape called "Tailuko valley" is due to the enormous

limestone bluffs and the deep valley. On the way from Tailuko to Tienshang, there occur the terrible precipices overhanging the valley continuously more than 20km in distance. HsIEH (1936) listed all the vascular plants found in the present district and pointed out that the endemic plants such as *Quercus tarokoensis*, *Spiraea tarokoensis*, *Diospyros sasakii* and *Chrysanthemum morii* were growing in this cliff region. Although surface of the cliffs is as the whole hardly covered with dense vegetation, the following plants are detectable here and there.

<i>Adiantum capillis-veneris</i>	A	<i>Leucas mollissima</i>	
A. caudatum	B	var. chinensis	B
<i>Cheilanthes</i> sp.	A	<i>Salvia keitaensis</i>	A B
<i>Cyclosorus acuminatus</i>	A	<i>Solanum biflorum</i>	A
<i>Drynaria fortunei</i>	A	S. nigrum	A
<i>Dryopteris eatoni</i>	A	<i>Titanotrichum oldhami</i>	A
<i>Equisetum</i> sp.	B	<i>Utricularia taikankoensis</i>	A
<i>Onychium japonicum</i>	A	<i>Justicia procumbens</i>	
<i>Pteris vittata</i>	A	var. hayatai	A B
<i>Pyrrosia polydactylis</i>	A	var. leucantha	B
<i>Selaginella delicatula</i>	A	<b><i>Galium tarokoense</i></b>	A
S. tamariscina	A	<i>Paederia scandens</i>	
<i>Pouzolzia elegans</i>	A	var. maritima	B
<i>Clematis meyeniana</i>	A	<i>Serissa japonica</i>	A
<i>Deutzia pulchra</i>	A	<b><i>Abelia chinensis</i></b>	A
<i>Rosa taiwanensis</i>	A	<i>Viburnum</i> sp.	A
<i>Rubus alnifoliolatus</i>	A	<b><i>Patrinia glabrifolia</i></b>	A
<b><i>Spiraea tarokoensis</i></b>	A	<i>Melothria mucronata</i>	A
<i>Campylotropis giraldii</i>	A B	<b><i>Adenophora morrisonensis</i></b>	A
<i>Cassia occidentalis</i>	B	<i>Campanumoea lancifolia</i>	A
<i>Euphorbia liukiensis</i>	A	<i>Anaphalis margaritacea</i>	
<b>E. tarokoensis</b>	A	ssp. morrisonicola	A
<i>Macaranga tanarius</i>	A	<i>Artemisia capillaris</i>	A
<i>Phyllanthus</i> sp.	B	<i>Aster taiwanensis</i>	A
<i>Ilex asprella</i>	A	<b><i>Chrysanthemum morii</i></b>	A
<b><i>Euonymus batakensis</i></b>	A	<i>Crepidiastrum lanceolatum</i>	
<i>Dodonaea viscosa</i>	A	f. batakense	A
<i>Berchemia lineata</i>	A	f. lanceolatum	A
<b><i>Rhamnus oiwakensis</i></b>	A	<i>Heteropappus hispidus</i>	A
<i>Ampelopsis brevipedunculata</i>	A	<i>Ixeris chinensis</i>	A
<i>Tetrastigma erubescens</i>	A	I. laevigata	
<b><i>Takasagoya geminiflora</i></b>	A	var. oldhami	A
<i>Buddleja asiatica</i>	A B	<i>Youngia japonica</i>	A
<b>B. formosana</b>	A	<i>Eupatrium luchuense</i>	A
<i>Thyrocarpus sampsonii</i>	A B	<i>Arundo donax</i>	A
<b><i>Clinopodium laxiflorum</i>*</b>		<i>Oplismenus compositus</i>	A
var. <i>parvifolium</i> , var. nov.	B		

\* *Clinopodium laxiflorum* (HAYATA) T. SHIMIZU, comb. nov.—*Calamintha laxiflora* HAYATA, Mater. Fl. Formos. 228 (1908).



Paspalum conjugatum	B	Spodiopogon tainanensis	
Pogonatherum crinitum	A	var. hogoensis	A

### 63. Tienchang cliff (Pref. Hualien)

On the way from Longchien to Chilai, we sometimes come across the limestone veins. Above all, the so-called Tienchang cliff (1630m~1700m elev.) near Chilai is the largest outcrop extending about 1km in width. Few trees grow there. Only some individuals of pines, a juniper, oaks and a viburnum inhabit limestone crevices or rubbly steep slopes much sporadically. *Cerastium calcicola*, *Thalictrum urbaini* var. *majus* *Arabis alpina*, *Viola rupicola*, *Anaphalis margaritacea* ssp. *morrisonicola* and *Chrysanthemum morii* are the striking herbs growing on rubbly slopes.

The vegetation in the neighbourhood of the present cliff region should be referred to Liu et al (1958). The following plants are all from outcrops of limestone between Longchien and Chilai.

<i>Adiantum capillis-veneris</i>	A	<i>Corydalis tashiroi</i>	A
<i>Aleuritopteris argentea</i>	A	<i>Arabis alpina</i>	A
? <i>Asplenium exiguum</i>	A	Flowers large and pinkish.	
A. <b>pulcherrimum</b>	A	<i>Astilbe longicarpa</i>	A
A. <b>ruta-muraria</b>	A	<i>Eriobortya deflexa</i>	A
<i>Cyrtogonellum fraxinellum</i>	A	<b><i>Spiraea prunifolia</i></b>	
<i>Hypodematium crenatum</i>	A	var. <b><i>pseudoprunifolia</i></b>	A
<i>Polystichum acutidens</i>	A	<i>Campylotropis giraldii</i>	A
<i>Onychium japonicum</i>	A	<b><i>Rhamnus oiwakensis</i></b>	A
O. sp.	A	<i>Sageretia theezans</i>	A
Near to <i>O. japonicum</i> , but with wider ultimate pinnula.		<b><i>Hypericum nokoense</i></b>	A
<b><i>Pteris deltoidea</i></b>	A	<i>Viola rupicola</i>	A
<i>P. vittata</i>	A	<i>Stachyurus himaraicus</i>	A
<i>Pyrrosia polydactylis</i>	A	<i>Myrsine africana</i>	A
<i>P. transmorrisonensis</i>	A	<b><i>Gentiana tentyoensis</i></b>	A
<i>Selaginella tamariscina</i>	A	<b><i>Clinopodium laxiflorum</i></b>	
<i>S.</i> sp.	A	var. <b><i>parvifolium</i></b>	A
<b><i>Struthiopteris eburnea</i></b>		<i>Euphrasia exilis</i>	A
var. <b><i>obtusa</i></b>	A	<i>Justicia procumbens</i>	
<i>Tectaria coadunata</i>	A	var. <b><i>riukiensis</i></b>	A
<i>Pinus formosana</i>	A	<b><i>Galium tarokoense</i></b>	A
<i>P. morrisonicola</i>	A	<b><i>Abelia chinensis</i></b>	A
<b><i>Juniperus formosana</i></b>	A	<b><i>Viburnum propinuum</i></b>	A
<i>Quercus stenophylloides</i>	B	<i>Anaphalis margaritacea</i>	
<i>Q.</i> sp.	A	ssp. <i>morrisonicola</i>	A
<b><i>Cerastium calcicola</i></b>	A	<b><i>Artemisia somai</i></b>	
<i>Dianthus superbus</i>		var. <b><i>batakensis</i></b>	A
var. <b><i>longicalycinus</i></b>	A	<i>Aster ageratoides</i>	
<b><i>Thalictrum urbaini</i></b>		ssp. <b><i>lasiocladus</i></b>	A
vas. <b><i>majus</i></b>	A	A. <b><i>taiwanensis</i></b>	A
<i>Berberis kawakamii</i>	A	<i>Bidens pilosa</i>	
		var. <b><i>radiata</i></b>	A
		<b><i>Chrysanthemum arisanense</i></b>	A

<b>C.</b>	<b>morii</b>	A	<i>Lilium philippinense</i>	
	<i>Ixeris laevigata</i>		var. <i>formosanum</i>	A
	var. <i>oldhami</i>	A	<b><i>Smilax elongato-reticulata</i></b>	A
	<i>Senecio scandens</i>	B	<i>Calanthe</i> sp.	A
	<i>Arundo formosana</i>	A	<i>Poneorchis</i> sp.	A
	<i>Carex daibuensis</i>	A	Near to <i>P. takasagomontanum</i> , but	
	<i>C. dolichostachya</i>	A	different from it by narrower leaves	
	<i>Dianella ensifolia</i>	A	and absence of rosettes.	

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