

A LIST OF THE FERNS AND FERN ALLIES FOUND IN ORCHID ISLAND, TAIWAN^(1,2)

LIEW FAH SEONG⁽³⁾

Abstract: There are 103 species of ferns growing in Orchid Island. Among them, 14 are "endemic" species not found elsewhere in Taiwan. The general phytogeography and floristic history of Orchid Island is briefly discussed. A list of the 108 ferns and fern allies found in Orchid Island and neighbouring Green Island is also given.

INTRODUCTION

Orchid Island is a lovely island situated in the Pacific Ocean some 68 kilometers off the East coast of Taiwan and 140 kilometers away from the Batan Islands at the northern end of the Philippine archipelago (see Fig. 1). Formerly, it was known as Botel Tobago or Kotosyo, and spelt in some maps as Lan Hsu or Lan-yu, both meaning literally in Chinese the 'island of orchids'. This island is actually famed for its beautiful and attractive 'butterfly orchids', *Phalaenopsis aphrodite* Reichb. and *P. ritewanensis* Masm. (Ma, 1954; Chen, 1955; Huang, 1957; Liu, 1961).

There are about 1,800 Yami aborigines living in six villages along the coastal plains of Orchid Island. This is by far the smallest and one of the primitive tribe of aborigines living in Taiwan. The Yami make their living by fishing and farming. The men fish in their small but artistic canoes or row-boats, raise their hogs and sheeps in the wilds, and the women farm, grow such crops and vegetables as taro, sweet potatoes and sugar cane, and such fruits as papaya, coconut and betel nuts (Wei & Liu, 1962).

GEOLOGY

Orchid Island covers an area of about 45 square kilometers (Inoue, 1934; Lin, 1967). It is an old volcanic island which was recently uplifted and which is geologically distinct from the main island of Taiwan (see Fig. 1). The central portion of Orchid Island is mostly formed by andesite while northern and southern central parts are andesitic stuff. Coral-limestones are found, in parts, along the northern, northwestern, and around the southern coasts. Only a small areas of alluvial deposit can be seen stretching along the eastern coastal region. Orchid Island belongs to the volcanic chain extending from northern Luzon through the Babuyan and Batan Islands of the Philippines to the Green Island (Lu-tao or Kwasyoto) and further North to the Turtle Island (Kuei-shan Tao) off the coast of I-lan.

Orchid Island is rather mountainous. The highest peak (Hung-tou Shan, 紅頭山) being of 548 meters above sea level. Some of the mountains are heavily cultivated or else utilized otherwise by the local inhabitants, e.g. Shiang-ai Shan (相愛山, 507 m) and Fun Shan (飯山, 407 m), while most of them still remain as virgin jungles and contain abundant firewoods and building materials for canoes or row-boats. We have botanized around Tien-tze (天池) and most

- (1) Research supported by a grant from the National Science Council.
- (2) Assistance in various ways by the following persons is gratefully acknowledged: S. C. Wang (王先志), M. C. Chen (陳明哲), C. M. Kuo (郭誠孟), M. T. Kao (高木村), and Y. Chen (陳吟). The author also thanks Professor Charles E. DoVol for reading the manuscript, and Mr. M. C. Chen for drawing Fig. 1.
- (3) 劉華祥, Associate Professor, Department of Botany.

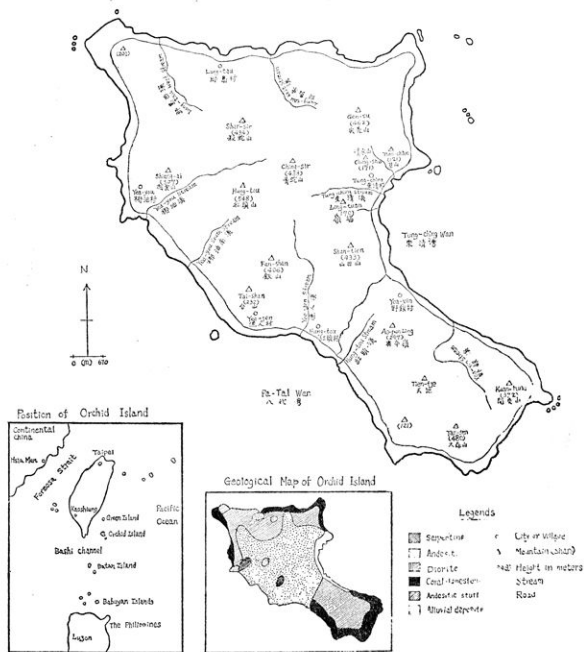


Fig. 1. Map of Orchid Island.

of the virgin jungles in these mountains. They include, from North to South and East to West, Gen-tu Shan (尖秃山, 462 m), Shar-sir Shan (殺蛇山, 494 m), Ching-sir Shan (青蛇山, 438 m), Hung-tou Shan (紅頭山, 548 m), Shan-tien Shan (山田山, 434 m), Tar-sen Shan (大森山, 480 m), and Kuan-tung Shan (觀東山, 377 m). There are many streams in Orchid Island. Some, like Yee-zen Stream (漁人溪), Yea-you South Stream (椰油南溪) and Tung-ching Stream (東清溪) flow the whole year round, and some, like Hung-tou Stream (紅頭溪) and Lung-tau West Stream (朗島西溪) do not.

CLIMATE

Orchid Island has a tropical climate (Chen, 1955; Chang, 1967; Liu & Liao, 1971). It is hot, humid and windy. The mean annual temperature is 25.4°C, with the highest in August (34.9°C) and the lowest in January (13.7°C). The mean annual rainfall is 3,440 mm, with the highest in October (658 mm) and the lowest in March and April (137 mm). Frequent and strong winds blow more than 260 days per year.

FLORA AND FERNS

In the past, a few naturalists were interested in the fauna and flora of this isolated and enchanting island (Kano, 1931; Sasaki, 1932; Kanehira, 1936). Early collections and studies were made mostly by the Japanese and later by Chinese investigators.

The flora and fauna of Orchid Island is rather peculiar (Merrill, 1923). According to previous studies and analyses (Kano, 1933; Kanehira, 1935; Suzuki, 1932; Li & Keng, 1950) it contains mainly Asian elements but many of the taxa found in Orchid Island belong to the Philippine and Malaysian series. Our preliminary phytogeographical analysis on the ferns of Orchid Island seems to indicate that more than a tenth of the fern flora belongs to elements found only in the Philippines and Malaysia and not found either in the island of Taiwan or neighbouring Okinawa, Hainan or continental China, indicating a close phytogeographical relationship to the Malesian areas. It also shows intimate connection with the fern flora of Guam of the Mariana Islands (Stone, 1971).

Several general floristic studies on the vascular plants of Orchid Island have been published, notably by Kawakami and Sasaki (1915), Liu, Sasaki and Keng (1955, 1957), Chang (1967), and Liu and Liao (1971). For ferns I would like to cite studies made or reports written by Yabe (1902, 49 ferns), Sasaki (1937, 89 ferns), Hatusima (1970, 61 ferns), and C. M. Kuo (1972, unpublished field trip report, 69 ferns).

Since Orchid Island is rapidly becoming a holiday resort with ever increasing number of local and/or foreign tourists pouring in every day, especially during weekends, and the increasing utilization of land and natural resources, it is an appropriate time for us to re-investigate the fern flora in this small island before they vanish or become permanently extinct. Accordingly, the author made several field study and collecting trips to Orchid Island during these past few years.

We found that the fern vegetation of Orchid Island is luxuriant and it is a paradise for field botanists. Although it is only about 1/800 the size of Taiwan, it has more than 1/6 of Taiwan's fern flora! There are the giant tree ferns like *Sphaeropteris lepifera* and the tiny ferns of the filmy fern family.

Ferns are found to inhabit all kinds of ecological habitats. *Azolla pinnata* is found floating, and *Marsilea crenata* and *Ceratopteris thalictroides* are found growing in paddy fields or on muddy banks. Along sandy coastal areas we will see *Pteris fauriei* and *Christella acuminata*, and the former is by far the commonest species found in these areas. Along banks of sandy streams and ponds one sees *Angiopteris palmiformis*, *Equisetum ramosissimum* ssp. *debile*, *Osmunda banksiaefolia*, *Pleuropteris decursive-pinnata*, *Ctenitis eatonii*, *Christella parasiticus*, *Macrothelypteris torresiana*, *Sphaerostephanos kotoensis*, *Anisogonium esculentum*, *Pteris vittata*, *Selaginella delicatula*, and many others. There are many petrophilous species, e.g. *Adiantum capillus-veneris*, *Lemmaphyllum microphyllum*, *Antrophyum sessilifolium*, *Selaginella tamariscina*, *Phymatodes scolopendrium*, and *Microsorium punctatum*. Epiphytic species are also abundant, e.g. *Crypsinus taeniatus* var. *palmatus*, *Pyrrosia adnascens*, *Vittaria angusta-elongata*, *Humata pectinata*, *Davallia solida* and *Lomariopsis spectabilis*. For climbing species we have *Lygodium japonicum* and 'carpeting' species,

Selaginella ciliaris. Finally, a dried-up pond (such as Tien-tze) will support the growth of *Helminthostachys zeylanica* and *Ophioglossum vulgatum*.

My colleagues and I collected a total of 103 species of ferns on Orchid Island. Fourteen of them are 'endemic' ferns, not found elsewhere in Taiwan. Two taxa newly collected in Orchid Island might possibly be new species. One is a *Tectaria* not found elsewhere in Taiwan. It is newly discovered on the southern slope of Shar-sir Shan. It differs from the common Orchid Island species of *Tectaria decurrens* in having a taller plant body (about 1.7 m. in height, but smaller than some *T. yunnanensis*), larger size (about 1 m. broad), more erect habit and with a larger number of parallel pinnae (4-8 pairs) stretching out laterally. Another one is a *Sphaerostephanos*. It was collected by C. M. Kuo in 1972. Unfortunately, fertile plant of this thelypteroid fern has never been discovered since his original collection of some sterile specimens. It might equally well be an abnormal variant or mutant species of *Sphaerostephanos*. However, we have not checked through all the jungles in Orchid Island and such an effort may ultimately prove the actual identity of this taxa.

ENUMERATION OF FERNS AND FERN ALLIES

The following is an updated list of 108 ferns and fern allies collected by the author and other workers, with 103 species found in Orchid Island and 5 additional ones collected from the neighbouring Green Island. Specimens collected by the author will be deposited in the herbarium of the Department of Botany, National Taiwan University. This is only a tentative listing and it will be revised whenever new or additional pteridophytes are found. (Alphabet in front of taxon stands for: a- 'endemic' species, found only in Orchid Island and some other places, but not found elsewhere in Taiwan; g- found in Green Island.)

Chinese Names	Family and Scientific Names	Citation of Representative Specimen
松葉蕨科 松葉蕨	PSILOACEAE 1. <i>Psilotum nudum</i> (L.) Beauv.	Liew 90161
石松科 過山龍	LYCOPODIACEAE 2. <i>Lycopodium cernuum</i> L.	Liew 9029
卷柏科 小笠原卷柏 緣毛卷柏 全緣卷柏 生根卷柏 密葉卷柏 膜葉卷柏 黑葉卷柏 萬年松	SELAGINELLACEAE 3. <i>Selaginella boninensis</i> Bak. 4. <i>S. ciliaris</i> (Retz.) Spring 5. <i>S. delicatula</i> (Desv.) Alston 6. <i>S. doederleinii</i> Hieron. 7. <i>S. involvens</i> (Sw.) Spring g 8. <i>S. leptophylla</i> Bak. 9. <i>S. mollendorffii</i> Hieron. 10. <i>S. tamariscina</i> (Beauv.) Spring	Kao 128548 Liew 90270 Liew 901 Liew 90485 Liew 90384 Liew 9101 Liew 9072 Liew 90523
木賊科 臺灣木賊	EQUISETACEAE 11. <i>Equisetum ramosissimum</i> Desf. subsp. <i>debile</i> (Roxb.) Hauke	Liew 90499
滿江紅科 滿江紅	AZOLLACEAE 12. <i>Azolla pinnata</i> R. Brown	Liew 90192
蘋科 南國田字草	MARSILEACEAE 13. <i>Marsilea crenata</i> Presl	Liew 90223

- 瓶爾小草科
錫蘭七指蕨 a 14. *Helminthostachys zeylanica* (L.) Hook. Liew 90372
瓶爾小草 15. *Ophioglossum vulgatum* L. Liew 90373
- 觀音座蓮屬科
蘭嶼觀音座蓮 a 16. *Angiopteris palmiformis* (Cav.) C. Chr. Liew 9084
觀音座蓮屬 a 17. *Marattia pellucida* Presl Liew 90522
- 紫萁科
粗齒革葉紫萁 18. *Osmunda banksiaefolia* (Pr.) Kuhn Liew 90173
- 海金沙科
海金沙 19. *Lygodium japonicum* (Thunb.) Sw. Liew 90139
小葉海金沙 20. *L. microphyllum* (Cav.) R. Brown Sato s. n. July 1, 1933
- 裏白科
芒萁 21. *Dicranopteris linearis* (Burm. f.) Under. Liew 9024
- 膜蕨科
HYMENOPHYLLACEAE
長片蕨 22. *Abrodictyum cunningii* Presl Huang & Kao 6293
菲律賓厚葉蕨 23. *Cephalomanes laciniatum* (Roxb.) DeVol Liew 9030
圓腎假脈蕨 24. *Crepidomanes bilabiatum* (Nees & Blume) Copel. Liew 90110
潤葉假脈蕨 25. *C. latemarginale* (Eaton) Copel. Liew 4099
厚邊蕨 26. *Crepidophyllum humile* (Forst.) Reed Liew 90157
圓扇蕨 27. *Gonocormus minutus* (Blume) v. d. Bosch Liew 90446
爪哇厚壁蕨 28. *Meringium blandum* (Racib.) Copel. Hosokawa 9837
厚壁蕨 29. *Meringium denticulatum* (Sw.) Copel. Kuo 2187
球桿毛蕨 30. *Nesopteris thysanostoma* (Makino) Copel. Shieh 424
線片長筒蕨 31. *Selenodesmium obscurum* (Blume) Copel. Liew 90425
瓶蕨 32. *Vandenboschia auriculata* (Blume) Copel. Liew 9042
大葉瓶蕨 33. *V. maxima* (Blume) Copel. Sasaki s. n. July 1912
漏斗瓶蕨 34. *V. naseana* (Christ) Ching Liew 90100
熱帶瓶蕨 35. *V. pyxidifera* (L.) Copel. Huang & Kao 6289
- 水蕨科
水蕨 36. *Ceratopteris thalictroides* (L.) Brongn. Liew 90215
- 抄羅科
CYATHEACEAE
蘭嶼筆筒樹 a 37. *Alsophila fenicis* (Copel.) C. Chr. Liew 90188
筆筒樹 38. *Sphaeropteris lepifera* (Hook.) Tryon Liew 90195a
- 烏毛蕨科
烏毛蕨 39. *Blechnum orientale* L. Liew 9050
東方狗脊蕨 40. *Woodwardia orientalis* Sw. Liew 9074
- 雙扇蕨科
DIPTERIDACEAE
雙扇蕨 41. *Dipteris conjugata* Reinw. Liew 90510
- 水龍骨科
POLYPODIACEAE
稀圓線蕨 42. *Colysis elliptica* (Thunb.) Ching Liew 9064
萊氏線蕨 43. *C. wrightii* (Hook.) Ching Liew 9093
掌葉線蕨 a 44. *Crypsinus taeniatus* (Sw.) Copel. var. *palmatus* (Blume) Tagawa Liew 90118
伏石蕨 45. *Lemmaphyllum microphyllum* Presl Liew 9075
骨牌蕨 46. *Lepidogrammitis rostrata* (Beddome) Ching Liew 9048a
箭葉星蕨 47. *Microsorium dilatatum* (Beddome) Sledge Yamamoto s. n. June 3, 1947

- 星蕨 48. *M. punctatum* (L.) Copel. Liew 9017
 廣葉星蕨 g 49. *M. steerei* (Harr.) Ching Kuo 3896
 海岸擬弗蕨 50. *Phymatodes scolopendria* (Burm.) Ching Liew 90102
 抱樹石蕨 51. *Pyrosia adnascens* (Sw.) Ching Liew 90203
- 書帶蕨科 VITTARIACEAE
 奧卑車前蕨 a 52. *Antrophyum sessilifolium* (Cav.) Spring Liew 90150
 姬書帶蕨 53. *Vittaria anguste-elongata* Hayata Liew 90156
- 碗蕨科 DENNSTAEDTIACEAE
 司氏碗蕨 54. *Dennstaedtia smithii* (Hook.) Moore Liew 90181
 粗毛鱗蓋蕨 55. *Microlepia strigosa* (Thunb.) Presl Liew 90162
- 陵齒蕨科 LINDSAEACEAE
 海島陵齒蕨 56. *Lindsaea connixa* Tagawa Liew 9021
 細脈陵齒蕨 57. *L. cultrata* (Willd.) Sw. Liew 90168
 圓片陵齒蕨 58. *L. orbiculata* (Lam.) Mett. ex Kuhn Liew 90255
 拳緣陵齒蕨 59. *L. yuejiamensis* Tagawa Liew 9086
 圓片烏蕨 a 60. *Sphaeromeris biflora* (Kaulf.) Tagawa Liew 90209
 烏蕨 61. *S. chusana* (L.) Copel. Liew 90229
 達邊蕨 62. *Tapeinidium pinnatum* (Cav.) C. Chr. Liew 9033
 二羽達邊蕨 a 62. *T. pinnatum* (Cav.) C. Chr. var. *biserratum* (Blume) Shieh Liew 90489
- 骨碎補科 DAVALLIACEAE
 調葉骨碎補 63. *Davallia solida* (Forst.) Sw. Liew 9037
 馬來陰石蕨 a 64. *Humata pectinata* (J. Sm.) Desv. Liew 9041
 鱗葉陰石蕨 65. *H. trifoliata* Cav. Kuo 2182
 熱帶陰石蕨 66. *H. vestita* (Blume) Moore Liew 90394
- 鳳尾蕨科 PTERIDACEAE
 天草鳳尾蕨 g 67. *Pteris dispar* Kunze Liew 9111
 傅氏鳳尾蕨 68. *P. fauriei* Hieron. Liew 9058
 鳳尾蕨 69. *P. multifida* Poir. Shieh *et al.* 316
 鱗蓋鳳尾蕨 70. *P. vittata* L. Liew 9083
- 鐵線蕨科 ADIANTACEAE
 鐵線蕨 71. *Adiantum capillus-veneris* L. Liew 9032
- 耳蕨科 OLEANDRACEAE
 腎蕨 g 72. *Nephrolepis auriculata* (L.) Trimen Huang 6962
 長葉腎蕨 73. *N. biserrata* (Sw.) Schott Liew 90213
 長葉腎蕨耳葉變種 a 73. *N. biserrata* (Sw.) Schott var. *auriculata* Ching Liew 90213a
 毛葉腎蕨 74. *N. hirsutula* (Forst.) Presl Liew 90211
- 三叉蕨科 ASPIDIACEAE
 愛德氏肋毛蕨 75. *Ctenitis eatoni* (Bak.) Ching Liew 90119
 肋毛蕨 g 76. *C. subglandulosa* (Hance) Ching Liew 9114
 海菜擬肋毛蕨 a 77. *Ctenitopsis dissecta* (Forst.) Ching Liew 90221
 翅柄三叉蕨 78. *Tectaria decurrens* (Pr.) Copel. Liew 90198
 雲南三叉蕨 79. *T. yunnanensis* (Bak.) Ching Liew 90405
- 羅蔓藤蕨科 LOMARIOPSIDACEAE
 尾葉實蕨 80. *Bolbitis heteroclita* (Pr.) Ching Liew 9037
 海南實蕨 81. *B. subcordata* (Copel.) Ching Liew 90475
 刺蕨 82. *Egenolfia appendiculata* (Willd.) J. Sm. Liew 9078
 羅蔓藤蕨 83. *Lomariopsis spectabilis* (Kunze) Mett. Liew 9038

鱗毛蕨科

DRYOPTERIDACEAE

- | | | |
|--------|---|--------------------------|
| 細葉複葉耳蕨 | 84. <i>Arachniodes aristata</i> (Forst.) Tindle | Liew 90165 |
| 小葉複葉耳蕨 | 85. <i>A. pseudo-aristata</i> (Tagawa) Ohwi | Liew 9057 |
| 全緣貫衆蕨 | 86. <i>Cyrtomium falcatum</i> (L. f.) Presl | Sasaki s. n. May 5, 1924 |

金星蕨科

THELYPTERIDACEAE

- | | | |
|-------|---|------------|
| 小毛蕨 | 87. <i>Christella acuminata</i> (Houtt.) Lév. | Liew 9080 |
| 密毛小毛蕨 | 88. <i>C. parasitica</i> (L.) Lév. | Liew 90377 |
| 非洲伏蕨 | a 89. <i>Leptogramma pozoi</i> (Lag.) Ching | Liew 90403 |
| 大金星蕨 | 90. <i>Macrothelypteris torresiana</i> (Gaud.) Ching | Liew 9088 |
| 短柄卵果蕨 | 91. <i>Phegopteris decursive-pinnata</i> (Van Hall) Fée | Liew 9082 |
| 稀毛蕨 | 92. <i>Pneumatopteris truncata</i> (Poir.) Holtt. | Liew 90104 |
| 頂芽新月蕨 | 93. <i>Pronopterium cuspidatum</i> (Blume) Holtt. | Liew 90154 |
| 三葉新月蕨 | 94. <i>P. triphyllum</i> (Sw.) Holtt. | Liew 9027 |
| 紅頭圓腺蕨 | a 95. <i>Sphaerostephanos kotoensis</i> (Hayata) Holtt. | Liew 90105 |

蹄蓋蕨科

ATHYRIACEAE

- | | | |
|---------|---|------------|
| 過溝菜蕨 | 96. <i>Anisogonium esculentum</i> (Retz.) Presl | Liew 90187 |
| 假蹄蓋蕨 | 97. <i>Athyriopsis japonica</i> (Thunb.) Ching | Liew 9055 |
| 廣葉鋸齒雙蓋蕨 | 98. <i>Diplazium dilatatum</i> Blume | Liew 90378 |
| 德氏雙蓋蕨 | 99. <i>D. doederleinii</i> (Luerss.) Makino | Liew 90408 |
| 細柄雙蓋蕨 | 100. <i>D. donianum</i> (Mett.) Tard-Blot | Liew 90259 |
| 單葉雙蓋蕨 | 101. <i>D. subsinatum</i> (Wall. ex Hook. & Grev.) Tagawa | Liew 90171 |

鐵角蕨科

ASPLENIACEAE

- | | | |
|--------|--|------------|
| 革葉鐵角蕨 | 102. <i>Asplenium adiantoides</i> (L.) C. Chr. | Liew 90142 |
| 大黑柄鐵角蕨 | 103. <i>A. cuneatum</i> Lam. | Liew 90217 |
| 剪葉鐵角蕨 | 104. <i>A. excisum</i> Presl | Liew 90114 |
| 熱帶山蘇花 | 105. <i>A. nidus</i> L. | Liew 90200 |
| 尖葉鐵角蕨 | 106. <i>A. ritoense</i> Hayata | Liew 90144 |
| 單邊鐵角蕨 | 107. <i>A. unilaterale</i> Lam. | Liew 9097 |
| 闊葉鐵角蕨 | a 108. <i>A. vulcanicum</i> Blume | Liew 90115 |

LITERATURE CITED

- CHANG, C. E. 1967. Forest plants of orchid island. Quart. J. Taiwan For. 3(2): 1-42. (in Chinese).
- CHEN, K. G., 1955. Geographical information about Botel Tobago. Continent Mag. 10: 366-368. (in Chinese).
- Editorial Committee of Flora of Taiwan, 1975. Flora of Taiwan. Vol. I. Pteridophyta and Gymnospermae. Epoch Pub. Co., Taipei, Taiwan.
- HATUSIMA, S., 1970. An enumeration of the plants collected by G. Ikeda in Botel Tobago Island. Mem. Facul. Agr. Kagoshima Univ. 7: 295-302.
- HUANG, D. H., 1957. Green Island and Orchid Island. J. Liter. 8: 39-69. (Chinese transl.).
- INOUE, G., 1934. The geology of Botel Tobago. Geogr. Mag. 42: 501-611. (in Japanese).
- KANEHIRA, R., 1935. The phytogeographical relationships between Botel Tobago and Phillipines on the bases of the ligneous flora. Bull. Biogeogr. Soc. Jap. 5: 209-211.
- _____, 1936. Formosan Trees. Revised ed. Dept. For., Govern. Res. Inst., Taihoku, Taiwan.
- KANO, T., 1931. Fauna of Botel Tobago. Bull. Biogeogr. Soc. Jap. 2: 77-94. (in Japanese)
- _____, 1933. A study on the animal biogeography of Botel Tobago. Geographical Review 9: 381-389. (in Japanese)
- KAWAKAMI, T. S. & SASAKI, 1915. A list of plants of Botel Tobago. Trans. Nat. Hist. Soc. Formosa 5(22) Appen-d. (in Japanese)
- LI, H. L. & H. KENG, 1950. Phytogeographical affinities of Southern Taiwan. Taiwania 1: 103-128.

- LIN, C. C., 1967. The geology of off-shore islands of Taiwan. *Quart. J. Taiwan Bank* **18**: 245-252. (in Chinese)
- LIU, C. H., 1961. Lan-yu: Its Present and Past. Common Knowledge Pub. Co., Taipei, Taiwan. (in Chinese)
- LIU, T. S. & J. C. LIAO, 1971. Ligneous plants of Botel Tobago. *Forestry Ser.* 49. *Exper. Forest Nat. Taiwan Univ.* (in Chinese)
- , S. SASAKI & H. KENG, 1955, 1957. An enumeration of the plants of Lanyu (Botel Tobago). *Quart. J. Taiwan Mus.* **8**: 283-328; **10**: 57-61.
- MA, K. L., Green Island and Orchid Island. New Century Pub. Co., Kaohsiung, Taiwan. (in Chinese)
- MERRILL, E. D., 1923. Die Pflanzengeographische Scheidung von Formosa und Philippinen. *Bot. Jahrb.* **48**: 599-621.
- SASAKI, S., 1932. The Flora of Botel Tobago. *Bull. Biogeogr. Soc. Jap.* **3**: 24-25. (in Japanese)
- , 1937. Phytogeographical and floristic studies in the Island-series of Kotosyo. Part I. Enumeration of hitherto known indigenous pteridophytes and their geographical distribution. *Dept. For., Govern. Res. Inst., Taihoku, Taiwan.*
- STONE, B. C., 1970-1971. The Flora of Guam. *Micronesica* **6**: 1-659.
- WEI, H. L. & P. H. LIU, 1962. Social Structure of the Yami tribe of Botel Tobago. *Inst. Ethn. Acad. Sinica Monographs No. 1* (in Chinese)
- YABE, Y., 1902. A note of ferns from the Island of Kotosyo (Botel-Tobago). *Bot. Mag. (Tokyo)* **16**: 45-53. (in Japanese)