

ATOLL RESEARCH BULLETIN

No. 287

CHECKLIST OF THE VASCULAR PLANTS OF THE
NORTHERN LINE ISLANDS

By

LYNDON WESTER

ISSUED BY
THE SMITHSONIAN INSTITUTION
WASHINGTON, D. C., U.S.A.

MAY 1985

CHECKLIST OF THE VASCULAR PLANTS OF THE NORTHERN LINE ISLANDS

By

LYNDON WESTER*

INTRODUCTION

The Northern Line Islands consists of four atolls aligned on an axis which runs from south east to north west. The three southern islands Christmas (Kiritimati), Fanning (Tabuaeran) and Washington (Teraina) have permanent populations and are part of the Republic of Kiribati (Table 1). The fourth island, Palmyra, on the north end of the chain, is an unoccupied U.S. possession.

Table 1
Northern Line Islands

| | Land area (sq. kms.) | Rainfall (millimeters) | Population | Political jurisdiction |
|------------|-------------------------|---------------------------|------------|---------------------------|
| Palmyra | 0.6 | 4161 | 0 | U.S. |
| Washington | 14.2 | 2902 | 417 | Kiribati |
| Fanning | 34.6 | 2086 | 434 | Kiribati |
| Christmas | 363.4 | 766 | 1288 | Kiribati |

Sources: Carter, 1984; Ministry of Education, Training and Culture, 1979; Taylor, 1973.

The islands are remarkably dissimilar considering their proximity. This is in part due to the fact that they lie across an abrupt rainfall gradient. Christmas in the south, in the equatorial dry belt, receives only 766 mm of rain per year, whereas the islands further north are influenced by the intertropical convergence to a progressively

* Department of Geography, University of Hawaii

greater extent. Palmyra, four degrees of latitude north, receives 4161 millimeters per year and supports a luxuriant forest.

The islands are also quite different in form. Christmas is a very large atoll; most of the land is one continuous surface which almost completely encircles an embayment or lagoon and there is a large protruding peninsula off to the southeast. The island contains extensive plains of limestone hardpan, numerous shallow pools, beach berms and sand dunes. The ocean coast is characteristically a sandy beach. Fanning on the other hand corresponds more closely to the popular image of an atoll as it is made up of three long, narrow islands which surround a shallow lagoon. Its ocean shore is covered almost completely with plate-like coral shingle and little sand. Washington is perhaps the most peculiar island of the group. It has the smallest coral platform and the island is lens-shaped. Instead of a lagoon open to the sea the central depression of the island contains a freshwater lake and two peat bogs. The shore has a narrow fringing reef usually covered on the landward side with a thin strip of sand. Although Palmyra is a slightly larger coral structure than Washington, it is mostly submerged reef. At the time of first survey the atoll consisted of about fifty tiny islets heavily vegetated down to high tide level; however dredging and reclamation have greatly increased its area.

The islands were uninhabited at the time of European discovery but there is ample evidence of former Polynesian occupancy (Emory, 1934, 1939; Finney, 1958). Whalers and traders stopped at the islands during the early nineteenth century but the first attempt at settlement was by a group from Hawaii in 1820. The colony of about forty people included both Europeans and Hawaiians but appears to have been a failure because most of the party had returned by 1822 (Maria Loomis, 1819-24; Elisha and Maria Loomis, 1820-24). Whalers who stopped by the island for wood or coconuts recorded an occasional castaway over the next two decades. However by 1840 a white man and 30 Society Islanders were living on the island and able to supply one of the ships engaged in the U.S. Exploring Expedition with "watermelon, taro and pumpkins" (Anonymous, 1838-41). Two years later a whaler reported the group was engaged in producing coconut oil and supplied them with arrowroot (Hussey, 1841-45). Edward Lucett arrived on Fanning in 1846 with a title and the intention of establishing a coconut oil industry. He noted that there was a "man of Crusoe habits" on the island who had an Hawaiian wife and a large family of children and grandchildren and was engaged in the raising of pigs. What happened to the earlier colony or whether this represented a relict of it is not clear (Lucett, 1851). In 1852 John English purchased the establishment and by 1854 seems to have expanded to Washington Island because a whaler who stopped there reported he was able to trade for "sweet potatoes, coconuts and bananas" (English, 1857; Holley, 1853-57). Washington has no safe anchorage and it may have been occupied only intermittently because when another whaler stopped there in 1861 he noted that the natives could provide nothing because they had only been there for a few months (Greene, 1860-65). English sold his interests in the islands to William Greig, his assistant, and George Bicknell in 1864 who switched to the

production of copra and were responsible for extensive planting of coconut on both Washington and Fanning. When George Bicknell died the operation of the plantation passed to the Greig family who remained there well into the twentieth century.

Drought-prone Christmas Island with only small natural stands of coconut had little to offer whalers except turtles and fish. Phosphate attracted guano diggers to Christmas Island in 1858 and some rock was also exported from Fanning Island between 1878 and 1881 but the Northern Line Islands were not among the major producers of phosphate rock. It was not until 1882 that more or less permanent occupation began on Christmas. Messrs Macfarlane and Henderson of Auckland took possession of the island in the name of their company and over the next few years their employees were engaged in the gathering of pearl shell from the lagoon and the planting of coconuts (Bailey, 1977).

When the British Commonwealth communications cable was constructed across the Pacific from Canada to Australia, a relay station was built on Fanning Island which operated from 1902 to 1963. This imposing facility, which had a permanent staff and could boast of a swimming pool, tennis courts and extensive gardens, enhanced the position of Fanning as the focus of human activity in the Line Islands. In 1902 Lever Brothers Ltd. acquired a lease of Christmas Island and financed a major coconut planting program. The Greigs and the heir of James Bicknell were forced to sell their interests in Washington and Fanning Island in 1907 although members of the Greig family remained to manage the plantation. The purchaser was Emmanuel Rougier who conveyed them to a company called Fanning Island Limited just a few years later. Meanwhile by 1914 he had taken over the Lever lease of Christmas Island and formed the Central Pacific Coconut Plantations Limited. He and later his nephew Paul Rougier ran the islands as a plantation. The Gilbert and Ellice Islands Company took over the running of the Christmas Island coconut plantation in 1941 after Paul Rougier became embroiled in criminal and political affairs and returned to France (Bailey, 1977). Washington and Fanning, the wetter and more productive islands, were acquired by Burns Philp & Co. who continued to operate them as coconut plantations until they sold them to the Kiribati government in 1983 (Republic of Kiribati, 1983).

During the Second World War New Zealand and American troops were garrisoned on Christmas Island and in 1956-58 Britain used the island for nuclear testing. The United States used it for similar purposes in 1962. All devices were detonated in the atmosphere and its most conspicuous martial legacy is 100 kilometers of sealed road and impressive quantities of abandoned equipment and rusting structures.

Palmyra Island escaped permanent settlement or significant modification until the United States established a military base there in 1940 which was eventually expanded to accommodate 6,000 personnel. The transformation of the island by dredging the lagoon, constructing causeways and building airstrips has been described in detail by Dawson (1959). The island was abandoned as a base in 1958 and plans to develop it as a plantation or a resort have come to nothing. It remains an

uninhabited U.S. possession recovering from profound disturbance.

In 1979 the Gilbert, Phoenix and Line Islands, formerly administered by the British, became Kiribati, an independent republic. It is the hope of the government to use the Line Islands, particularly Christmas, to settle people from heavily overpopulated South Tarawa, in the Gilbert group. However the economic prospects for development of the Line Islands are small, and the problem of transport and communication with the administrative and population center far to the west, is great. Improvements to the airport and the construction of an hotel were sponsored by the Japanese government who built and maintains a down-range missile tracking station on Christmas Island. A small tourist industry exists on Christmas based on game fishing and some fish are exported to Honolulu. Copra production has diminished almost to zero. However the government is presently engaged in a study of the agricultural potential of the newly acquired Washington and Fanning Islands.

SUMMARY OF THE LAND FLORA

The indigenous land flora of vascular plants consists largely of widespread strand and coral island species. Endemism is low, as is to be expected on an atoll. The only endemic species which have been described from the islands belong to genera which, for one reason or another, pose many problems for the systematist. Hence the status of these taxa (Asplenium pacificum, Pandanus fanningensis, P. hermsianus, four varieties of P. fischerianus, Portulaca fosbergii and P. johnii) is in doubt. Only nine indigenous species, out of a total of 42, occur on all of the islands in the group and the significant differences in the floras, and the character of the vegetation communities, can be related to rainfall (Table 2). The smaller but wetter islands (Palmyra and Washington) are mostly covered by closed forest and have more indigenous species than the much larger Christmas Island. The vegetation of the latter consists of either sickly coconut plantation or low scrub. Fanning receives sufficient rainfall to support closed canopy forests of Cocos, Pisonia and Pandanus but extensive tracts of land are inundated during high tides and these mudflats support mainly Lepturus grass.

Table 2
Origin and status of species

| | Indigenous | Cultivated or persisting | Adventive | TOTAL |
|------------|------------|-----------------------------|-----------|-------|
| Palmyra | 21 | 14 | 23 | 58 |
| Washington | 25 | 46 | 20 | 91 |
| Fanning | 23 | 70 | 30 | 123 |
| Christmas | 19 | 25 | 25 | 69 |

Similarity indices calculated on the basis of the entire indigenous flora (Table 3) show a high level of similarity between Palmyra and Washington and, to a slightly lesser extent, between those two islands and Fanning. Christmas, on the other hand, is quite dissimilar from Palmyra and Washington but bears considerable similarity to Fanning.

Table 3
Similarity indices: indigenous species

| | Washington | Fanning | Christmas |
|------------|------------|---------|-----------|
| Palmyra | 78.2 | 63.6 | 40.0 |
| Washington | | 62.5 | 36.4 |
| Fanning | | | 61.9 |

Calculations based on Sorensen index of similarity

$$SI = \frac{\text{number of species common to both islands}}{1/2 (\text{total species on island A} + \text{total species on island B})} \times 100$$

The concentration of introduced species shows a distinctly different pattern. Fanning has many more cultivated and adventive species, which can probably be explained by its suitability for horticulture and its long history as the headquarters for the main plantation on the islands. Kyte (1861) remarked on the variety of crops which were grown on the plantation and the owners went so far as to bring soil from Honolulu for their gardens. Many other plants were imported for the extensive gardens of the Cable Station and even today a number of ornamental species persist despite the lack of care. Washington might have been equally suitable to support crops plants or ornamentals but it lacks a safe anchorage and so fewer introductions have occurred. Most of the exotic species recorded from Palmyra were introduced when it served as a military base. The severely disturbed areas are still suitable habitats for adventive species but the introduced plants will probably be replaced if no further human interference occurs. It would appear that some adventive species recorded in the nineteenth century have since disappeared. The guano digger John Arundel for example collected Achyranthes aspera and Asclepias curassavica on Fanning but they have not been recorded since and we can assume they are locally extinct.

There is a much lower level of similarity between the assemblages of adventive species on the different islands (Table 4). Furthermore the patterns of similarity are somewhat different. The highest similarity is between Fanning and Washington which is probably because they are both wet, have experienced similar human use and indeed been operated as a single plantation for most of their recent history.

Table 4
Similarity indices: adventive species

| | Washington | Fanning | Christmas |
|------------|------------|---------|-----------|
| Palmyra | 41.9 | 45.3 | 45.8 |
| Washington | | 56.0 | 53.3 |
| Fanning | | | 43.6 |

The pattern of similarity between the cultivated species on islands shows a similar pattern to that of the adventives (Table 5). Fanning and Washington again show a high level of similarity furthermore Fanning, Washington and Christmas together as a group seem to have much in common but are quite dissimilar from Palmyra. This may be because Palmyra has had a very different history of human occupation and disturbance.

Table 5
Similarity indices: cultivated or persisting

| | Washington | Fanning | Christmas |
|------------|------------|---------|-----------|
| Palmyra | 30.0 | 21.4 | 35.9 |
| Washington | | 65.5 | 53.5 |
| Fanning | | | 46.3 |

PLANT COLLECTORS OF THE NORTHERN LINE ISLANDS

Of the four islands of the Northern Line Islands, Christmas and Fanning have received most attention from plant collectors because they are more accessible. A few specimens remain from collections gathered in the nineteenth century but the first systematic inventories were made by participants in expeditions sent by the Bishop Museum in the 1920's and 30's. Since that time there have been other efforts which have added one or two new indigenous species to the known flora and made it possible to keep track of introductions. A summary of information about each of the collectors who have worked in the Northern Line Islands, and the disposition of their specimens, has been compiled for reference.

Arundel, John T. was a trader and guano digger who became one of the leading figures in the Pacific phosphate industry (Langdon, 1974). He was at first a field manager for the British firm of Houlder Bros. and Co. which operated in the equatorial Pacific islands. He later went into the business himself and, between 1883 and 1891, operated from Apia using mostly Niue and Cook Island laborers. At various times he held leases for many of the dry guano islands. He traveled extensively and is known to have visited the Line Islands in 1873. Between 1879 and 1881 he directed the guano mining on Fanning (Arundel, 1870-1919). On

one these trips he apparently collected 21 specimens on Fanning and other islands, which were sent to Joseph Hooker at Kew (Arundel, 1890). From these a list was compiled (Anonymous, 1874-86) which was reported in part by Hemsley (1855) in the results of the Challenger Expedition. His specimens are preserved at Kew.

Ball, Stanley C. was a zoologist and Curator of Collections at the Bishop Museum who participated in the Fanning Island Expedition in the company of C.E. Edmondson. They made comprehensive biological collections during a ten day stay on Fanning in July and August 1922 (Edmondson, 1923; Gregory, 1923). Ball made the collections of plants which, along with his field notebooks, are in the Bishop Museum. In 1924 Ball was on Christmas and again on Fanning Island but this time in the company of G.P. Wilder as members of the scientific party on the "Cruise of the Kaimiloa" sponsored, in part, by the Bishop Museum. Ball made no further collections at this time.

Bennett, Frederick Debell was the surgeon on board a whaling ship which circumnavigated the globe between 1833 and 1836. During the voyage he stopped on Christmas Island (6-10 May, 1835) and made extensive plant collections. A list of the plants collected was published along with his account of the voyage (Bennett, 1970). His specimens from this voyage were sent to Berlin Herbarium (Lanjouw and Staflen, 1954) and presumably destroyed during the Second World War. It is possible that some duplicates may exist at the British Museum or at Kew.

Bergman, H.F. and Erling Christophersen were botanists on the Whippoorwill Expedition sent to the Line Islands by the Bishop Museum. Bergman was responsible for systematic collecting and made extensive collections while on Christmas (31 July and 7 August) and on Washington (13-18 August 1924) (Gregory 1925). He also visited Fanning with other members of the expedition but on this island Christophersen seems to have made all of the collections. His specimens are preserved in the Bishop Museum and the U.S. National Herbarium and were used in the preparation of a detailed report on the vegetation of the islands by Christophersen (1927).

Browne, Ashley was employed by the University of Hawaii Agricultural Extension, and selected as a member of the official party of a ship dispatched to supply a group of young men from Honolulu who were living on the Southern Line Islands (Bryan, 1974). The ship stopped at Palmyra on 17 October 1939 during which time Browne collected a few specimens which are now at Berkeley.

Bryan, Edwin H. was Curator of Collections at the Bishop Museum when he made at least two stops on Palmyra Island during the 1930's. He travelled with ships which transported and supplied young men from Honolulu who were sent to occupy the Southern Line Islands in an effort to strengthen the United States's claim to that territory. In the course of these voyages the ships visited the Northern Line Islands. During stops on Palmyra (23 March 1935 and 11-12 August 1938) Bryan took the opportunity to make collections of plants (Bryan, 1974). His specimens

are in the Bishop Museum and the U.S. National. However the labels show confusion, in some cases, about the site of collection.

Christophersen, Erling and H.F. Bergman were the botanists on the Whippoorwill Expedition sent by the Bishop Museum to survey the Line Islands. It was the responsibility of Christophersen to study the ecological aspects of the islands. However he also made all the collections on Fanning during their stay (29-30 July) and both men collected while they were on Christmas (31 July to 7 August)(Gregory, 1925). However all the collecting on Washington appears to have been done by Bergman. Christophersen wrote a detailed report of the vegetation of the Line Islands based on these observations (Christophersen (1927)).

Cooke, Charles Montague Jr. was a malacologist at the Bishop Museum who accompanied Henry Cooper and Joseph Rock on an expedition to Palmyra Island in 1913 (Rock 1916). He was a leader of "Trip B" of the Whippoorwill Expedition which visited the Line Islands again in 1924 (Gregory, 1924); however all of their important work was done on Baker and Howland Islands. Cooke was the leader of the Mangarevan Expedition, sponsored by the Bishop Museum, which stopped at Fanning Island (20-29 April 1934) on the way south. In the course of the return journey they called at Christmas Island (21-22 October) and again at Fanning (23 October). The botanists of the party were Harold St. John and F. Raymond Fosberg who did most of the collecting independently of Cooke (Kondo and Clench, 1952).

Cooper, Henry E. was a judge in Honolulu and President of the Board of Regents of the College of Hawaii. In 1913, soon after purchasing the island of Palmyra, he took a group of scientists on an expedition of exploration. Joseph Rock wrote the report of the trip (Rock, 1916). Cooper was listed along with C.M. Cooke as a collector on that expedition. However Cooper collected plants independently on another visit to Palmyra in 1914. All specimens were given to the Bishop Museum.

Dawson, E. Yale, a marine biologist, was on Palmyra (15-21 October 1958) for the purpose of studying ciguatera fish poisoning. He documented the considerable changes caused by the construction of a military base on the island during the Second World War (Dawson, 1959). His extensive collections of both native ruderal and cultivated species are preserved in the Bishop Museum and the U.S. National Herbarium.

Fosberg, F. Raymond first visited the islands as a member of the Mangarevan Expedition which stopped at Fanning Island (20-29 April 1934) during the journey south and at Christmas Island (21-22 October) and again at Fanning (23 October) on the voyage home. At this time Fosberg was acting as an assistant to Harold St. John. Fosberg again collected on Christmas Island (16 August 1936) in the company of Alfred Metraux and his wife E.M. Metraux. His specimens are in the Bishop Museum and the U.S. National Herbarium.

Gallagher, M.D. was a major in the British armed forces stationed on Christmas Island from June 1958 to mid June 1959 during a series of atomic tests. He was the founder and guiding spirit of the Natural History Society of Christmas Island established for the purpose of fostering interest in wildlife. A series of bulletins were issued which contained useful information about the plants and animals of the island (Anonymous, 1962). Major Gallagher made collections of plants which he sent to the Bishop Museum and published an article based on his observations of the birds (Gallagher, 1960).

Hamilton, Dean C. made collections and observations of plants on the northern portion of Christmas Island in the vicinity of Main Camp while conducting an entomological survey of the island for the Plant Quarantine Division, Agricultural Research Service of the United States Department of Agriculture (11-14 April 1962). In collaboration with Alvin K. Chock, then of the Botany Department, Bishop Museum, a list of plants of the island was published in the Atoll Research Bulletin (Chock and Hamilton, 1962). The specimens are preserved in the Bishop Museum.

Herms, William B. was an entomologist from the College of Agriculture of the University of California, Berkeley who, with Harold Kirby Jr., a graduate assistant, spent four months in the Line Islands investigating the pests of coconut. He spent most of his stay from 3 May to 27 July 1924 on Fanning Island. However he and his assistant made a short foray to Washington Island (13-16 May) during which Herms was largely incapacitated (Herms, 1925; 1926). They made collections of plants on both islands. Christophersen (1927) informs us that E.D. Merrill prepared a manuscript of a flora of the islands based on these collections and that it was preserved in the Bishop Museum library. A search was made for this manuscript but it could not be located. However Christophersen further stated that he had incorporated its information into his published work.

Hill, F.L. made collections on Christmas Island on 25 October 1957 and they are presently in the Bishop Museum. No other information about the collector has been found.

Hill, Margaret was a school teacher employed by the Civil Aeronautics Authority during the time they maintained a base on Palmyra Island. In October 1949 she made a collection of 25 plants from the vicinity of the inhabited area of Menge islet. The plants, mostly ruderals, were identified by Marie C. Neal and E.H. Bryan and are preserved in the Bishop Museum (Dawson, 1959).

Jenkin, R. N. and M.A. Foale conducted a study of the potential of Christmas Island for growing coconuts for the Directorate of Overseas Studies of the British Government during 1965 and 1966 (Jenkin and Foale, 1968). They spent August and September 1965 on Christmas Island doing the field portion of the study and during that time Jenkin collected plant specimens. At least some of the specimens are at Kew.

Judd, Albert F. was a trustee of the Bishop Museum who went as a member of the official party on the ship supplying groups of young men sent to

occupy the Southern Line Islands. He and D. Mitchell made collections while on Palmyra Island (13 June 1935) which were placed in the Bishop Museum.

Kirby, Harold Jr. was a graduate student in zoology from the University of California who accompanied William Herms to Fanning, and presumably Washington Island, to study insect pests attacking the coconut. Extensive collections on both islands were made. They arrived at Fanning on 3 May and Kirby remained until 3 October although Herms left near the end of July. They made a short foray to Washington (13-16 May) (Herms, 1925; 1926). Otherwise most of Kirby's time was spent on Fanning although he joined the scientific party of the Whippoorwill Expedition sent by the Bishop Museum when they stopped on Fanning (Gregory, 1925).

Lee, Mary Ann Bacon, a geographer from the University of Iowa, spent several weeks on Fanning in July 1983 to conduct a study of the effect of land crabs on the germination and spread of seeds. She collected plants mainly in the vicinity of the Cable Station and they are preserved in the Bishop Museum.

Long, C.R. participated in the Pacific Ocean Biological Survey whose goals included an inventory of the terrestrial flora of islands of the Northwest Hawaiian Chain and the atolls of the Central Pacific. Long made two voyages to the Line Islands, during which he collected extensively. In the course of the first trip in 1964 he stopped on Palmyra (6-7 June), Washington (9-10 June) and Christmas (14-16 June) on the way south and at the same islands on the return trip Christmas (21-23 November), Washington (25-26 November), and Palmyra (27-28 November). In the following year on the return leg of a voyage to the southern islands he stopped again on Christmas Island (25-30 June) and for the first time on Fanning (2 July). The main set of his specimens, his collection records and notebook are housed in the herbarium of the Bishop Museum. There are in additional specimens in the U.S. National Herbarium.

Metraux, Alfred, an anthropologist and ethnologist, along with his wife E.M. Metraux, was on Christmas Island (16 August 1936) with Fosberg and made extensive collections which are now in the Bishop Museum and U.S. National Herbarium.

Mitchell, Donald D., of Kamehameha Schools in Honolulu, travelled with the official party on the ship taking former students from the school who were sent to occupy the Southern Line Islands. He was on Palmyra Island (13 June 1935) and, in the company of A.F. Judd, made collections of plants which are preserved in the Bishop Museum (Bryan 1974).

Moeller, Henry S. collected on Palmyra Island (28 December 1959 to 3 January 1960) and his specimens are preserved in the Bishop Museum.

Perry, Roger collected on Christmas (August 1979) and on Washington (June 1979) islands. His specimens are in Kew.

Rock, Joseph Francis Charles was a botanist at the College of Hawaii (which was later to become the University of Hawaii) who made important

contributions to the understanding of the flora of Hawaii and China. He and a zoologist from the Bishop Museum were invited by the owner of Palmyra, Henry E. Cooper, to accompany him on an expedition to that island in 1913. They made extensive collections between July 12 and 28th and Rock wrote a detailed description of the island illustrated by excellent photographs (Rock, 1916). The publication, produced in cooperation with several specialists, includes lists of fungi, lichens, mosses, ferns and higher plants as well as descriptions of new species and forms. Specimens are preserved in the Bishop Museum and the U.S. National Herbarium. Rock also wrote a popular account of the trip which was published in the Atlantic Monthly (Rock, 1929).

Russell, Dennis J. and Roy T. Tsuda collected on Fanning Island in July 1972 while they were graduate students in botany at the University of Hawaii. Their specimens were presented to the Bishop Museum and were consulted by Harold St. John when he prepared the flora of Fanning (St. John, 1974).

St. John, Harold was the botanist on the Mangarevan Expedition led by C. Montague Cooke and sponsored by the Bishop Museum. With the assistance of F. Raymond Fosberg he collected on Fanning Island (20-29 April 1934) during the southward passage and on Christmas Island (21-22 October) and Fanning (23 October) on the voyage back to Honolulu (Gregory, 1935). Collections were made by St. John and Fosberg as well as St. John and Cooke. The specimens are preserved in the Bishop Museum. St. John also made the determinations of the specimens collected by Russell and Tsuda on Fanning in 1972 and prepared a flora of this island (St. John, 1974).

Tsuda, Roy T. and Dennis J. Russell collected on Fanning in July 1972 while they were graduate students in botany at the University of Hawaii. Their specimens were presented to the Bishop Museum and were consulted by Harold St. John in the preparation of the flora of the island (St. John, 1974).

Streets, Thomas H. was the assistant surgeon on board the U.S.S. Portsmouth, commanded by Joseph S. Skerrett, which was engaged in the United States North Pacific Surveying Expedition between 1873 and 1875. This was a hydrographic survey conducted by the U.S. Navy to check hazards to navigation in the Pacific and Lower California. In the course of this they stopped on Palmyra (12-27 December 1873), Washington (31 December 1873 to 3 January 1874), Fanning (4 January 1874) and Christmas Islands (14-22 January 1874) (Skerrett, 1873-4). Streets and the surgeon, William H. Jones, made plant collections and gathered information on animal life sufficient to write three articles on the birds and natural history of the islands (Streets, 1876, 1877a, 1877b). Most of the plant specimens were sent ahead to Asa Gray who made determinations. By the time Streets returned from the expedition the specimens had been distributed through the herbarium of the Department of Agriculture. No complete list of the specimens had been made. The list later published by Streets was based on duplicates he had retained of material collected on Palmyra, Washington and Christmas Islands (Streets, 1877a). Some of Streets' specimens are in the U.S. National Herbarium. On the labels the

collector was first shown as Dall (or Dale) but this has been crossed out and replaced by the name Dr. Streets.

Wester, Lyndon L. made collections during two trips to the Northern Line Islands. In the course of a reconnaissance of the vegetation in 1982 he collected on Fanning (4-11 August), Washington (6 August) and Christmas (12-19 August). In the following year a longer stay was made on Washington Island (7-21 August) in the company of James O. Juvik and Paul Holthus for the purposes of conducting a vegetation survey and obtaining peat from the bog for pollen analysis. Transport to Washington required stops on Fanning Island and some additional collecting was done (6-7 and 21-22 August). All specimens are preserved in the Bishop Museum.

Wilder, Gerrit Pamile was an horticulturalist who, along with S. Ball, was a member of the scientific party on the "Cruise of the Kaimiloa". Wilder made plant collections during stops on Fanning (27 November to 7 December 1923) and Christmas (8-17 December). The specimens were deposited in the Bishop Museum (Gregory, 1925).

CHECKLIST

In the list of species below the presence of a species on one or other of the Northern Line Islands is indicated by the symbols P (Palmyra), W (Washington), F (Fanning) or C (Christmas). This is followed by the names (abbreviated) of the person, or persons, who have collected specimens consulted for this work. In some instances parties of two or three collectors visited an island at the same time and made collections both individually and in pairs or trios. The various combinations of collectors were not differentiated and any plants collected by members of that group are designated in the same manner. The abbreviations for collectors and groups of collectors are indicated below.

Most of the specimens taken from the Line Islands are in the herbarium of the Bernice P. Bishop Museum, Honolulu. The location of a specimen is indicated in round brackets () after the collector's name only if it is housed in an herbarium other than the Bishop Museum.

A few important specimens seem to be lost, or at least not found in the obvious place for them. They are shown in square brackets []. Species not represented by specimens in herbaria at all, but which have been directly observed by the author or recorded in the literature by a reliable source, are designated "observed".

| | | | |
|-----|---------------------|-----|-----------------------------|
| Adl | Arundel | HiF | Hill, F.L. |
| Bal | Ball | HiM | Hill, Margaret |
| Ben | Bennett | Jen | Jenkin |
| Ber | Bergman | J&M | Judd and Mitchell |
| Brn | Brown | Lee | Lee |
| Bry | Bryan | Lng | Long |
| Cht | Christophersen | Moe | Moeller |
| Cok | Cooke | Pry | Perry |
| Cop | Cooper | RCC | Rock, Cooke and Cooper |
| Cur | Curlett | R&T | Russell and Tsuda |
| Daw | Dawson | StJ | St. John |
| F&M | Fosberg and Metraux | S&F | St. John and Fosberg |
| Gal | Gallagher | SFC | St. John, Fosberg and Cooke |
| Gri | Griggs | Sdg | Sledge |
| Ham | Hamilton | Str | Streets |
| H&K | Herms and Kirby | Wes | Wester |
| | | Wil | Wilder |

* Introduced by Polynesians or in historic time

[] Specimen was not seen.

() Herbarium where the specimen is housed if other than Bishop Museum.

Herbaria

| | |
|----|--|
| K | Kew |
| UC | University of California, Berkeley |
| US | U.S. National Museum of Natural History. |

PSILOTACEAE

Psilotum nudum (L.) Beauv.

Found mostly as an epiphyte on bases of coconut trunks.

P - Daw, Lng(K)

W - Ber, Pry(K), Wes

F - R&T, Wes.

ASPLENIACEAE

Asplenium nidus L.

Holtttum described A. pacificum from a plant grown at Kew. The spores were obtained from a specimen collected on Washington Island. However the status of this taxon, as distinct from A. nidus, will only be clear when the genus is studied more closely. It is one of the most common epiphytes and understory species on Palmyra and Washington.

P - RCC, Bry(K), Bry

W - Ber, H&K(UC), Sdg(K), Pry(K), Wes.

NEPHROLEPIDACEAE

Nephrolepis exaltata Schott

Locally abundant as an epiphyte on trunks in understory. Some doubt exists about this species. Sledge did not give a specific name to the specimen he collected and F. M. Jarrett felt that the Perry specimen was intermediate between E. biserrata and E. hirsutula.

W - Str(US), Ber, Pry(K), Wes.

N. hirsutula Forst.

Appears on Palmyra and shows distinct differences from the species on Washington..

P - Daw, Lng.

POLYPODIACEAE

Phymatodes scolopendria (Burm. f.) Ching

Very common epiphyte and forms dense understory in coconut forest.

Recorded as Polypodium aureum by Streets and Polypodium scolopendria or Microsorium scolopendria several others.

P - RCC, J&M, Brn.

W - Str(US), Ber(K), H&K(UC), Wes.

F - Adl(K), Bal, Cht, H&K(UC), R&T ,Wes.

ARAUCARIACEAE

*Araucaria sp.

A few large trees planted as ornamentals around the Cable Station on Fanning.

F - R&T, Wes.

1.

PANDANACEAE

Pandanus sp.

A new species recognised by St. John but not yet published.

F - STC.

1. Fosberg (Kew Bull. 31:837-840, 1977) regards all of the Pandanus taxa listed here as minor taxa, cultivars, or individuals of Pandanus tectorius Parkinson.

P. fanningensis St. John

A species known from only two specimens collected in 1972 near the Cable Station on Fanning.

F - R&T.

P. fischerianus Martellivar. rockii (Mart.) B.C. Stone

A specimen from Palmyra collected by Rock was described by Martelli (in Rock 1916) as a new species, P. rockii. However Stone (1968) believed this taxon is better regarded as a variety of P. fischerianus.

P - RCC, J&M, Moe.

var. cooperi (Mart ex Rock) B.C. Stone

Material collected by Rock from Palmyra was described by Martelli (in Rock, 1916) as a new variety of P. pulposus (var. cooperi Mart. ex Rock). However after intensive study of the Pandanus of the Marshall Islands Stone (1968) concluded that this taxon is better regarded as a form of P. fischerianus.

P - RCC

*var. pulposus (Warburg) B.C. Stone forma bergmanii (F.Br.) B.C. Stone

A specimen collected by Bergman on Washington Island was described by Brown (1930) as a new species, P. bergmanii F. Br.. Stone (1968) believed this to be a cultivated variety similar to some found in the Gilbert Islands and possibly introduced by workers. He concluded that this taxon should be regarded as a form of P. fischerianus.

W - Ber

var. bryanii B.C. Stone

A specimen collected by Bryan on Palmyra in 1935 was described as a new variety of P. fischerianus by Stone (1968). St. John (1983, pers. comm.) believes that this taxa should be raised to the species level but he has not published the new name. This wild species has also been collected on Washington Island.

P - Bry.

W - Wes.

P. hermsianus Mart.

A single phalange collected on Fanning Island by Herms was the basis upon which Martelli (1926) described the species P. hermsianus Mart. He believed the phalange had drifted from elsewhere and that the species was not native to Fanning. Stone (1968) thought there was insufficient material to create a new species but St. John (1972) concluded that a specimen he and Fosberg collected on Fanning in 1934 belonged to this taxon and was able to provide a more complete description.

F - H&K(UC), S&F.

*P. tectorius Parkinsonvar. nova-caledonicus Mart.

St. John (1972) believes this to be a cultivated species introduced to Fanning Island by Gilbertese laborers. Furthermore he thinks the specimen collected by Long in 1965 is the same as one photographed by Herms in 1924.

F - Lng

POTAMOGETONACEAE

Potamogeton sp.

A sterile specimen, said to have been collected by Bergman in the lake of Washington Island (Christophersen, 1927).

W - [Ber].

POACEAE

*Cenchrus echinatus L.

A common grass on atolls but perhaps not native.

P - HiM.

W - Wes.

F - S&F, R&T, Wes.

C - Gal, Ham, Wes.

*Chloris inflata Link

An adventive on Palmyra in 1949 (Dawson, 1959).

P - HiM

*Cynodon dactylon (L.) Pers.

A common lawn species on Washington and Fanning.

W - Ber, Wes.

F - H&K(UC), Wes.

*Dactyloctenium aegyptium (L.) Willd.

An uncommon weed in waste areas around Napia village on Fanning.

Perhaps a new arrival.

F - Wes.

Digitaria pacifica Stapf

This is the Syntherisma pelagica F. Brown (variety b) which was described in Brown (1931) and the plant identified by Christophersen (1927) as Panicum stenotaphrodes Nees. ex Stend.

C - Ber, SFC, F&M, Gal, Lng, Wes.

*Digitaria sp.

In grassy areas around village on Washington. Said by one of the residents to be a new arrival.

W - Wes.

*Eleusine indica (L.) Gaertn.

A common volunteer in waste places.

P - Daw.

W - Ber, Wes.

F - S&F, R&T, Wes.

C - Gal, Ham, Lng, Wes.

*Eragrostis ciliaris (L.) R.Br.

Rare in waste areas.

C - Wes.

*E. pilosa (L.) Beauv.

Rare in waste areas

C - Wes.

*E. tenella (L.) Beauv. ex R. & S.

Recorded as E. amabilis (L.) Wight and Arnott by Christophersen (1927) and Chock & Hamilton (1962). A common weed.

W - Ber, Wes.

F - H&K(UC), R&T, Wes.

C - Ber, Gal, Wes.

E. whitneyi Fosb.

Listed as E. falcata (Gaud.) Gaud. by Christophersen (1927) (See Fosberg, 1939)

C - Ber, SFC, F&M, Lng,

Lepturus repens (Forst. f.) R.Br.

Common in natural and open areas, along roads and in understory where shading is not excessive. This was designated as "Haemoenthuia confitessa" on the list of plants collected by Arundel.

P - RCC(K), Bry, J&M, Daw, Lng.

W - Ber, Lng, Wes.

F - Adl(K), Bal, Cht, Wil, H&K(UC), Lng, R&T, Wes.

C - Ber, SFC, F&M, Gal, Ham, Lng, HiF(K), Wes.

*Panicum maximum Jacq.

Misidentified as P. barbinode Trin.

C - S&F.

*Paspalum fimbriatum H.B.K.

Dawson (1959) found this naturalized on Cooper islet of Palmyra.

P - Daw.

*P. orbiculare Forst. f.

Dawson (1959) found this naturalized on Menge islet of Palmyra.

P - Daw.

*Rhynchelytrum repens (Willd.) C.E.Hubb.

Also known as Tricholaena rosea Nees. Small colony perpetuating itself around Fanning Is. Cable Station.

F - R&T, Wes.

*Saccharum officinarum L.

Cultivated in village on Washington.

W - observed.

*Sporobolus indicus (L.) R. Br.

= S. poiiretii (R. & S.) Hitch.

On Palmyra Dawson (1959) found naturalized on Menge islet and in disturbed area on Cooper Island and has characteristic large, almost oblong seeds. Another specimen of Sporobolus is in the Bishop Museum with a notation on the label which reads "could be from Palmyra according to Bryan".

P - Daw, Lng.

*Stenotaphrum secundatum (Walt.) O. Kuntze

Planted as a lawn around Cable Station on Fanning but is spreading somewhat in to waste areas. Included in St. John (1972) list as Brachiaria plantaginea.

F - R&T, Wes.

CYPERACEAE

*Cyperus compressus L.

A few individuals found in waste area near airport terminal. Perhaps a new introduction.

C - Wes.

C. javanicus Houtt.

A conspicuous but uncommon sedge on Washington found mainly near wier and in disturbed areas. Also listed as C. pennatus Lamarck.

P - Daw.

W - Ber, Sdg(K), Wes.

*C. kyllingia Endl.

A small colony found in grassy area of village on Washington. Perhaps a new introduction.

W - Wes.

C. polystachyos Rottb.

A common sedge in standing water at fringes of bog and on elevated mounds in bogs of Washington.

P - HiM, Daw, Lng.

W - Ber, Lng, Sdg(K), Wes.

*C. rotundus L.

An uncommon sedge found near habitations.

F - R&T, Wes.

C - SFC, F&M, Sdg(K).

Fimbristylis atollensis St. John

A common sedge found extensively in dry open natural sites and in waste areas around human habitations. Often combined with F. cymosa R. Br. This is the species which Christophersen listed as

F. spathacea Roth.

P - HiM, Daw, Lng.

W - Ber, Lng, Wes.

F - Bal, Cht, Wil, H&K(UC), R&T, Wes.

C - Ham, Lng, Wes.

Scirpus littoralis Schrader

The dominant species over most of the bog on Washington. Also determined as S. riparius Presl by Streets and Christophersen.

W - Ber, Sdg(K), Wes.

ARECACEAE

*Cocos nucifera L.

Reported in earliest accounts of all the islands but it may have been an aboriginal introduction. Not represented in herbarium collections.

P - observed

W - observed

F - observed

C - observed

*Phoenix dactylifera L.

A few individuals grown in cultivation on Fanning.

F - observed by Wes.

*Livistona chinensis (Jacq.) Mart.

A single specimen by main building of Cable Station on Fanning.

F - observed by Wes.

ARACEAE

*Colocasia esculenta (L.) Schott

Anonymous, 1940, Keyte (1861) and Bryan (1942) reported seeing it in cultivation on Fanning.

F - observed

*Cyrtosperma chamissonis (Schott.) Merr.

Cultivated on Fanning and Washington for food but also naturalized or persisting in bog on Washington. This could also be the "ape" reported by Judd (1859).

W - Ber, Wes.

F - observed

- *Scindapsus aureus (Linden ex André) Engl.
 = Epipremnum aureum (Linden ex André) Bunting.
 It was introduced as an ornamental to Palmyra but has become locally naturalized.
 P - Daw.

BROMELIACEAE

- *Ananas comosus (L.) Merr.
 Bryan (1942) reported seeing it in cultivation on Fanning.
 F - observed.

COMMELINACEAE

- *Rhoeo spathacea (Sw.) Stearn
 A cultivated ornamental on Fanning.
 F - R&T, Wes.

LILIACEAE

- *Cordyline fruticosa (L.) Chev.
 A cultivated species also listed as C. terminalis (L.) Knuth.
 W - Wes.
- *Gloriosa superba L.
 A cultivated ornamental which persists in waste places around Cable Station on Fanning and on Washington.
 W - Wes.
 F - R&T, Wes.

AMARYLLIDACEAE

- *Agave sisalana Perrine ex. Engelm.
 A few individuals were observed on Fanning by wharf at Cartwright Point on north side of main pass.
 F - observed
- *Crinum amabile Donn
 Cultivated around Cable Station. Also known as C. augustum Roxb. and C. procerum Herbert and Carey. More material is needed of this plant for study.
 F - Wes.
- *C. asiaticum L.
 A robust species found in cultivation on Washington, Fanning and Christmas.
 W - Wes.
 F - observed
 C - observed
- *C. bulbispermum (Burm. f.) Milne-R. & Schw.
 Cultivated around Cable Station on Fanning.
 F - Wes.
- *Hymenocallis littoralis (Jacq.) Salisb.
 Cultivated species seen around Cable Station on Fanning. Also known as Pancratium littorale Jacq.
 F - Wes.
- *Zephyranthes grandiflora Lindl.
 Cultivated species on Fanning and Washington which appears to have escaped into waste areas on Washington.
 W - Wes.
 F - Lng, Wes.

TACCACEAE

**Tacca leontopetaloides* (L.) Ktze.

This cultivated species which was observed by Hussey (1841-45), Lucett, (1851), and Bryan (1942) on Fanning. It grows wild on many atolls and could be an aboriginal introduction or may have been brought by the early settlers. It persists in abandoned gardens near Cable Station on Fanning.

F - Wes.

MUSACEAE

**Musa paradisiaca* L.

This cultivated species was recorded on Washington at least from 1854 (Holley, 1853-57).

W - observed by Wes.

F - observed by Wes.

C - observed by Wes.

CANNACEAE

**Canna glauca* L.

Cultivated in garden of plantation manager on Fanning in 1983.

F - observed by Wes.

CASUARINACEAE

**Casuarina equisetifolia* L.

Cultivated trees recorded from all islands.

P - Daw.

W - Wes.

F - R&T, Wes.

C - Lng, Wes.

MORACEAE

**Artocarpus altilis* (Parkins.) Fosb.

In cultivation on Fanning, Washington and Christmas but groves were observed on Washington in remote areas which seemed to be reproducing naturally.

W - observed by Wes.

F - R&T, Lng.

C - observed by Wes.

**Ficus carica* L.

A cultivated tree on Washington and Fanning.

W - Wes.

F - Adl(K).

**F. prolixa* Forst f.

Large, mature trees found along roads and at sites of former camps on Washington.

W - Wes.

F - Adl(K), Wes.

**F. tinctoria* Forst. f.

In cultivation around settlements.

F - Wes.

C - Wes.

URTICACEAE

*Pilea microphylla (L.) Liebm.

A widespread naturalized species on Palmyra
P - HiM, Daw, Lng.

Laportea ruderalis (Forst. f.) Chew

Rock (1916) reported it to be abundant on Palmyra at the time of his visit. Common on Fanning and Washington usually in open areas often far from habitations. Also recorded as Fleurya ruderalis (Forst. f.) Gaud. ex Wedd.

P - RCC, Bry, J&M, Lng.

W - Ber, Lng, Sdg(K), Wes.

F - Adl, Bal, Cht, H&K(UC), S&F, Lng, R&T, Lee, Wes.

Pipturus argenteus (Forst. f.) Wedd.

An understory shrub where canopy is open and a colonist in cleared areas.

W - Lng, Sdg(K), Wes.

POLYGONACEAE

*Antigonon leptopus H. & A.

Cultivated in garden around Cable Station on Fanning.

F - Wes.

*Coccoloba uvifera (L.) L.

A cultivated tree observed by Dawson (1959) on Menge, Marine Engineer and Cooper islets of Palmyra where it appears to be naturalized or persisting.

P - HiM, Daw.

AMARANTHACEAE

*Achyranthes aspera L.

= A. indica (L.) Mill.

Presumed to be a naturalized species collected by Arundel but has not been recorded since. There appears to be some confusion between this species and A. indica (L.) Mill.

F - Adl(K).

*Amaranthus viridis L.

An uncommon naturalized herb.

W - Ber, Wes.

NYCTAGINACEAE

Boerhavia tetrandra Forst. f.

Very common on Christmas but present in open areas and disturbed sites on all islands. The taxonomy of this species or group of species needs attention. B. repens L. sensu lato may also be present and the name B. diffusa L. has been misapplied to some specimens from these islands.

P - RCC, Bry, J&M(K), Daw, Lng.

W - Ber, Lng, Wes.

F - Bal, Wil, H&K(UC), Lng, R&T, Wes.

C - Ber(K), Lng, Cur(K), Gri(K), Jen(K), Sdg(K), Wes.

*Bougainvillea sp.

Cultivated and persisting in abandoned gardens. It is unclear to me which species is present.

W - Wes.

F - Wes.

C - observed

*Mirabilis jalapa L.

Found cultivated and as an escape in waste areas near settlements.

W - Wes.

F - R&T,

C - Lng.

Pisonia grandis R.Br.

Forms splendid forests on Fanning, Washington and Palmyra and a few small groves on Christmas.

P - RCC, Cop, Bry, Daw, Lng.

W - Ber, Wes.

F - Wil, H&K(UC), S&F, Lng, Wes.

C - Wes.

AIZOACEAE

Sesuvium portulacastrum (L.) L. var. griseum Deg. and Fosb.

Mat forming species found in areas subject to flooding and high salinity.

F - Adl(K), H&K(UC), R&T, Wes.

C - Str(US), SFC, Gal, Ham, Lng, Wes.

PORTULACACEAE

P. johnii v. Poelln.

A specimen collected by St. John and Cooke from a small island in the lagoon of Christmas Island was among the specimens consulted by von Poellnitz when he described the species (v. Poellnitz, 1936)

C - SFC

P. lutea Soland. ex Forst. f.

Very common on Christmas and in open areas on Fanning.

F - Cht, H&K(UC), R&T, Lee, Sdg(K), Wes.

C - Ber, Wil, SFC, F&M, Gal, Ham, Lng, Wes.

*P. oleracea L.

A cosmopolitan species which, in the Line Islands as elsewhere, is commonly found along roadsides and waste areas. Von Poellnitz (1936) recognized two closely related species, P. fosbergii v. Poelln. and P. johnii v. Poelln., which colonized natural habitats. Fosberg (1943) speculated that P. fosbergii was intermediate between P. oleracea and P. lutea but thought that further study of living material was needed to establish the relationship between these species. Geesink (1969) reduced both P. fosbergii and P. johnii to synonyms. Rock (1916) noted a single plant of what he called P. oleracea on Holei Island of Palmyra atoll but appears not to have collected it. Dawson (1959) found P. oleracea (which he listed as P. fosberii) which is probably the same species as Rock saw.

P - Daw.

W - Wes.

F - Adl(K), R&T, Wes.

C - F&M, Gal, Ham, Lng, Wes.

ANNONACEAE

*Annona squamosa L.

A cultivated species on Fanning collected by Bergman and also noted by Bryan (1942).

F - Ber.

LAURACEAE

Cassytha filiformis L.

Very common on Christmas and found in a few open habitats on Fanning and Washington.

W - Ber, Wes

F - H&K(UC), R&T.

C - Ber, F&M, Gal, Ham, Wes.

HERNANDIACEAE

*Hernandia sonora L.

= H. nymphaeifolia (Presl) Kub.

This provisional determination is based on sterile material. A few individuals found cultivated on Washington.

W - Wes.

CRUCIFERAE

*Brassica oleracea L.

Cultivated in gardens on Fanning from an early date (Keyte, 1861) and also seen on Washington and Christmas.

W - Wes.

F - observed by Wes.

C - observed by Wes.

Lepidium bidentatum Mont.

Locally common in open habitats and in some artificial clearings. Also recorded as L. owaihiense C. & S. and L. piscidium Forst.

P - Str(US), RCC, J&M, Bry.

W - Ber, Lng, Wes.

F - Adl(K), Cht, H&K(UC), S&F, Lng, R&T, Wes.

C - Cht, Lng.

CRASSULACEAE

*Kalanchoe pinnata (Lam.) Pers.

A cultivated species which persists in abandoned gardens.

F - Long, R&T, Wes.

FABACEAE

*Bauhinia monandra Kurz

St. John (1972) reported that this species was collected by Long but the specimen can not be located.

F - observed

*Caesalpinia pulcherrima (L.) Sw.

A cultivated shrub observed by Russell and Tsuda on Fanning (St. John, 1972).

F - observed

Canavalia carthartica Thouars

Common strand species on Washington. This is the C. microcarpa (DC.) Piper of Christophersen (1927) and probably the C. grandiflora recorded by Streets (1877).

W - [Str], Ber, H&K(UC), Lng, Sdg(K), Wes.

*Cassia occidentalis L.

A volunteer in open areas around settlements.

F - Adl(K), H&K(UC), Wes.

*Crotalaria incana L.

Locally naturalized on Palmyra.

P - Daw, Lng.

*C. retusa L.

Locally naturalized around Napari on Fanning.

F - Wes.

*Crotalaria sp.

One sterile specimen found in waste area on Washington.

W - Wes.

*Delonix regia (Boj.) Raf.

Ornamental in village on Washington.

W - Wes.

*Desmodium triflorum (L.) DC.

Reported to grow along paths in coconut groves by Christophersen (1927).

F - H&K(UC).

*Erythrina variegata L. var. orientalis (L.) Merr.

Christophersen (1927) reported E. indica was grown as an ornamental on Christmas and Bryan (1942) also observed an Erythrina on that island growing around settlements.

C - observed

*Leucaena leucocephala (Lam.) De Wit

Occasionally naturalized in and around settlements. Also reported as L. glauca sensu Hawn. bot. non (L.) Benth.

P - Daw.

W - Lng, Sdg(K), Wes.

F - R&T, Wes.

C - SFC, F&M, HiF.

*Peltophorum pterocarpum (DC.) Backer ex K. Heyne

Large ornamental tree near Cable Station. Sterile specimen misidentified as Jacaranda acutifolia Humb. & Bonpl. (St. John, 1972).

F - R&T, Wes.

*Phaseolus lathyroides L.

One record from Paris on Christmas Island.

C - F&M.

*Trifolium sp.

Sterile plant found in lawn of plantation manager's house on Fanning.

F - Wes.

*Vigna luteola Benth. in Mart.

This plant, which is rare in the Pacific, was found naturalized around Napia village of Fanning Island and was determined by Fosberg.

F - Wes.

ZYGOPHYLLACEAE

Tribulus cistoides L.

Common creeping herb on Christmas.

C - Cht, HiF, Gal, Ham, Wes.

RUTACEAE

*Citrus aurantiifolia (Christm.) Swingle

Cultivated in on Washington and Fanning.

W - Wes.

F - observed

SIMAROUBACEAE

Suriana maritima L.

Common shrub on saline soils on Christmas. Streets (1877a) indicates specimens were collected from Christmas and Palmyra and the plant was "common on all the islands of the Fanning Group" although this is doubtful. One small colony was noted on Fanning in 1982. Small populations may have been missed by recent collectors on Washington and Palmyra or it may be that the species is periodically exterminated but is able to recolonize these two islands.

P - [Str].

F - Wes.

C - Str(US), Ber, Wil, SFC, F&M, Ham, Lng, Sdg, Wes.

EUPHORBIACEAE

*Acalypha wilkesiana Muell. -Arg. in A.DC.

A cultivated shrub in settlements.

P - Lng.

W - Wes.

F - R&T, Wes.

*Breynia disticha Forst. f.

Cultivated shrub on Fanning.

F - Wes.

*Codiaeum variegatum (L.) Bl. var. pictum (Lodd.) Muell.-Arg.

Cultivated shrub in villages.

W - Wes.

F - R&T, Wes.

*Euphorbia glomerifera (Millsp.) L.C.Wheeler

Introduced weed on Palmyra (Dawson, 1959). One plant seen in waste area around village on Christmas. The species identified as E. atoto Forst. f. which appears on the Hill list (Dawson, 1959) is also believed to be E. glomerifera.

P - HiF, Daw.

C - Wes.

*E. heterophylla L. var. cyathophora (Murr.) Griseb.

Common around Cable Station on Fanning and in disturbed areas on other islands. Also known as E. cyathophora Murr.

P - HiM, Daw.

W - Wes.

F - R&T, Wes.

C - Wes.

*E. hirta L.

Common weed in waste areas and along roadsides.

P - [HiM].

W - Ber, H&K(UC), Wes.

F - Bal, H&K(UC), R&T, Wes.

C - Ber, F&M, Sdg(K), Pry(K), Wes.

*E. prostrata Ait.

Common weed in waste areas and heavily disturbed sites.

W - Ber, Sdg(K), Wes.

F - H&K(UC), Lee.

C - Wes.

*Manihot esculenta Crantz

Cultivated in villages.

W - Wes.

F - R&T.

*Phyllanthus amarus Schum.

Common weed misidentified as P. niruri L. (Christophersen, 1927) and as P. debilis Klein ex Willd. (Dawson, 1959).

P - Daw.

W - Ber, H&K(UC), Wes.

F - Bal, Cht, H&K(UC), R&T, Wes.

C - Ber, F&M.

ANACARDIACEAE

*Mangifera indica L.

Cultivated in settlements on Fanning and Washington.

W - Wes.

F - observed by Wes.

TILIACEAE

Triumfetta procumbens Forst. f.

Native to Polynesia, Micronesia and Malaya (Neal 1965) and used for fiber, ornament, magic and medicine (Luomala, 1953). Probably native to the Northern Line Islands but conceivably a human introduction.

P - Daw, Lng.

W - Lng.

F - Adl(K), Bal, H&K(UC), R&T, Lee, Wes.

MALVACEAE

*Abutilon albescens Miq.

Locally abundant on Christmas. Wrongly identified as A. indicum Sweet (Fosberg, 1943).

C - F&M.

*Hibiscus rosa-sinensis L.

Cultivated and persisting around settlements on Washington, Fanning and Christmas.

W - Wes.

F - Wes.

C - observed by Wes.

*Hibiscus tiliaceus L.

Cultivated and escaped around settlements.

P - HiM, Daw.

W - Wes.

C - Ber, F&M, Ham, Wes.

*Malvastrum coromandelianum (L.) Garcke.

Naturalized in waste areas.

W - Ber, Wes.

F - H&K(UC), Wes.

Sida fallax Walp.

One of the most common shrubs on Christmas. Streets (1877a) recorded it as S. dielli Gray, which is probably the same, and Christophersen (1927) misidentified it as S. cordifolia.

F - Adl(K), Bal(K), H&K(UC), R&T.

C - Str(US), HiF, Wes.

*S. rhombifolia L.

In disturbed habitats around settlements.

W - Ber, Wes.

C - Ber.

STERCULIACEAE

*Waltheria indica L.

Also known as W. americana L. One colony found near Cable Station, perhaps a new arrival.

F - Wes.

GUTTIFERAE

*Calophyllum inophyllum L.

Cultivated trees around villages.

P - Daw.

W - Wes.

F - Cht, Wes.

PASSIFLORACEAE

*Passiflora foetida L.

Weed around Cable Station on Fanning.

F - R&T, Wes.

CARICACEAE

*Carica papaya L.

Cultivated in settlements of Washington, Fanning and Christmas and mostly used for pig food.

W - Wes.

F - Wes.

C - observed by Wes.

COMBRETACEAE

*Terminalia catappa L.

Cultivated around settlements.

P - Daw.

W - Wes.

F - Wes.

C - observed by Wes.

MYRTACEAE

*Psidium guajava L.

Cultivated around settlements.

W - Ber, Wes.

F - Wes.

ONAGRACEAE

Ludwigia octovalvis (Jacq.) Raven

Found in flooded substrate near lake on Washington.

P - Him, Daw.

W - Lng, Wes.

ARALIACEAE

*Polyscias fruticosa (L.) Harms

Cultivated in gardens.

W - Wes.

*P. guilfoylei (Bull) Bailey

Cultivated in gardens.

F - S&F, R&T, Wes.

*P. scutellaria (Burm. f.) Fosberg

Cultivated in gardens.

W - Wes.

F - R&T, Wes.

OLEACEAE

*Ligustrum sp.

The specimen collected by Russell and Tsuda (St. John, 1972) can not be located in the Bishop Museum. It may have been redetermined or lost.

F - [R&T]

APOCYNACEAE

*Nerium oleander L.

Cultivated and persisting in abandoned gardens.

F - R&T, Wes.

C - observed by Wes.

Ochrosia oppositifolia (Lam.) K. Schum.= Neisosperma oppositifolia (Lam.) Fosb. and Sacht.

Found only near west end of Holei islet of Palmyra.

P - Him, Daw.

*Plumeria obtusa L.

Cultivated as ornamental and used in leis. Observed on Washington, Fanning and Christmas.

W - Wes.

F - observed by Wes.

C - observed by Wes.

*P. rubra L. forma rubra

Cultivated as ornamental and used in leis.

W - Wes.

F - observed by Wes.

C - observed by Wes.

(P. rubra)forma acutifolia (Poir.) Woodson

Cultivated as ornamental and used in leis. Probably also on Christmas.

W - Wes.

F - Wes.

ASCLEPIADACEAE

*Asclepias curassavica L.

An introduced weed which was collected by Arundel last century but not recorded since.

F - Adl(K).

CONVOLVULACEAE

Cuscuta campestris Yuncker

Common at South East Point of Christmas Island and occasionally between small ponds (Garnett, 1981).

C - Lng, Wes.

*Ipomoea batatas (L.) Poir.

Cultivated in village on Washington in 1854 (Holley, 1853-57). Now found cultivated and growing along nearby roadsides.

W - Wes.

I. pes-caprae ssp. brasiliensis (L.) v. Ooststr.

A pioneer on beaches and in open sites.

P - Daw, Lng.

W - Ber, H&K(UC), Wes.

F - R&T, Wes.

I. macrantha R. & S.Recorded also as I. tuba (Schlecht.) G. Don, I. grandiflora (Choisy) Hall f. and I. glaberrima Bojer. A common vine on Fanning and locally abundant on Washington.

P - Bry, Daw.

W - Ber, Wes.

F - S&F, Lng, R&T, Wes.

*Merremia dissecta Hallier

In Cable Station garden on Fanning and identified by the author.

F - Wes.

BORAGINACEAE

*Cordia sebestena L.

Cultivated tree in London village on Christmas.

C - Wes.

C. subcordata Lam.

In scattered locations usually not far from beach. On Washington it seemed to be associated with fresh water seeps.

W - Ber, Wes.

F - Bal, R&T, Lee, Wes.

Heliotropium anomalum (H. & A.) var. mediale Johnst.

Very common on Christmas and in open sites on Fanning.

F - Adl(K), Bal, Cht, Wil, H&K(UC), S&F, R&T, Sdg(K), Lee, Wes.

C - Ber, Wil, SFC, F&M, Gal, Ham, Jen, Cur, HiF, Gri, Wes.

Tournefortia argentea L. f.

Typically a string of these trees is found along the top of the beach. Also recorded as Messerschmidia argentea (L.f.) Johnst.

P - RCC, Bry, J&M.

W - Ber, H&K(UC), Wes.

F - Bal, H&K(UC), Wes,

C - Ber, SFC, F&M, Ham, Lng, Wes.

VERBENACEAE

*Clerodendrum inerme (L.) Gaertn.

A favored ornamental grown as a hedge and for its flowers which are used in leis. It has become established at a number of sites in the bog on Washington.

W - Sdg(K), Wes.

F - S&F, Lng, R&T, Sdg(K), Wes.

*Lantana camara L.

Cultivated in villages where flowers are used in leis.

W - Wes.

F - R&T.

*Premna obtusifolia R. Br.

Cultivated in village on Washington.

W - Wes.

*Stachytarpheta urticaefolia (Salisb.) Sims

Apparently common on Palmyra and found once on Fanning.

P - HiM, Daw, Lng.

F - R&T.

*Vitex trifolia L.

Cultivated around Cable Station on Fanning and persists on Palmyra and is the same as V. negundo var. bicolor (Willd.) H. Lam (Dawson, 1959).

P - HiM, Daw.

F - Wes.

LABIATAE

*Ocimum basilicum L.

Cultivated in gardens

F - S&F.

SOLANACEAE

*Capsicum annuum L.

Cultivated in settlements. Persists for a while after garden has been abandoned.

W - observed by Wes.

F - Wes.

C - observed by Wes.

*Lycopersicon esculentum Mill.

= Solanum lycopersicum L.

Cultivated on Fanning and Christmas but volunteers were noticed in waste areas on Christmas.

F - observed by Wes.

C - Lng, Wes.

*Nicotiana tabacum L.

Cultivated and able to resist attacks by land crabs.

F - Adl(K).

C - observed by Wes.

*Physalis minima L.

A volunteer in disturbed areas; determined by D. Symon.

W - Wes.

C - Wes.

SCROPHULARIACEAE

*Russelia equisetiformis Schlecht. & Cham.

A cultivated species which is able to persist after abandonment of garden.

W - Wes.

F - Lng, R&T, Wes.

BIGNONIACEAE

*Spathodea campanulata Beauv.

Cultivated tree on Washington and Fanning.

W - Wes.

F - observed by Wes.

*Tecoma stans (L.) Juss. ex B.& H.

Also known as Stenolobium stans (L.) D. Don and prized for its flowers.

W - Wes.

F - R&T, Wes.

ACANTHACEAE

*Blechnum brownei Juss.

Dawson (1959) recorded the species Blechnum brownei. This is assumed to be a typographical error since no fern by this name can be found and the species was listed with other Acanthaceae. The specimen could not be located in the Bishop Museum where Dawson's specimens are preserved.

P - [Daw].

*Graptophyllum pictum (L.) Nees ex Griff.

Said to be persisting on Palmyra (Dawson, 1959).

P - [Daw]

*Pseuderanthemum carruthersii (Seem.) Guillaum.

A common cultivated ornamental around settlements.

P - Daw.

W - Wes.

F - Lee, Wes.

C - Wes.

RUBIACEAE

*Spermacoce assurgens R. & P.

Also listed as S. suffrutescens Jacq. and misidentified as Borreria laevis (Lam.) Griseb. A common weed in disturbed areas and along roadsides.

P - Daw.

W - Sdg(K), Wes.

F - S&F, Lng, R&T, Wes.

*Gardenia taitensis DC.

Cultivated on Washington and Fanning but not common.

W - Wes.

F - observed by Wes.

*Guettarda speciosa L.

Cultivated around villages for fragrant flowers which are used in leis. The plant appears to volunteer around margins of settlements. It was once collected on Palmyra (Dawson, 1959). Could be native to the Line Islands.

P - [HiM].

W - Wes.

F - Wil, S&F, R&T, Lee, Wes.

C - Lng.

Hedyotis romanzoffiensis (C. & S.) Fosb.

A few populations found on Christmas in vicinity of ponds and lagoons.

C - Ber, SFC, F&M, Lng, Wes.

*Morinda citrifolia L.

Found mostly in disturbed areas around villages and a few natural sites. Probably introduced but could be native to these islands.

W - Ber, Lng, Wes.

F - Bal, R&T, Wes.

C - observed by Wes.

CUCURBITACEAE

*Curcubita pepo L.

Reported to be cultivated on Fanning in 1840 (Anonymous, 1838-41).

Now found in villages on Washington, Fanning and Christmas.

W - observed by Wes.

F - Wes.

C - observed by Wes.

*Citrullus lanatus Schrad. in Ecklon and Zeyher.

Reported on Fanning in 1840 (Anonymous, 1838-41).

F - observed by Wes.

GOODENIACEAE

Scaevola sericea Vahl

Recorded also by synonyms S. taccada (Gaertn.) Roxb. and S. koenigii Vahl. Streets misidentified it as S. plumieri (L.) Vahl. This common strand shrub forms dense thickets on Fanning and Christmas Island. It occurs in a few patches on Washington and is a colonist of disturbed habitats on Palmyra (Maragos, 1979).

P - J&M, Bry, HiM.

W - Ber, Wes.

F - Bal, H&K(UC), S&F, Wes.

C - Str(US), Ber, SFC, F&M, Gal, Ham, Wes.

ASTERACEAE

*Bidens pilosa L.

A weed in disturbed areas around settlements.

W - Lng, Wes.

F - S&F, R&T, Sdg(K), Wes.

*Emilia sonchifolia (L.) DC.

An occasional volunteer on Palmyra.

P - Daw.

*Erechtites hieracifolia (L.) Raf.

This introduced weed was misdetermined as E. valerianaefolia (Wolf) DC. and appeared in the Dawson (1959) list under that name. It has since been redetermined by Fosberg as the closely related E. hieracifolia.

P - HiM.

*Erigeron bonariensis L.

=Conyza bonariensis L.

The E. canadensis L. which appeared in the Dawson (1959) list has been redetermined as E. bonariensis. This is probably the same as the E. albidus (Willdenow) A. Gray recorded by Christophersen (1927) on Fanning.

P - HiM, Daw.

F - H&K(UC).

*Gaillardia pulchella Foug.

An ornamental which has volunteered extensively around the Cable Station on Fanning.

F - R&T, Wes.

*Pluchea indica (L.) Less.

Present on Palmyra and found in a few locations on Christmas.

P - Bry, HiM, Daw.

C - Ham, Sdg(K), Wes.

*P. X fosbergii Cooperider & Galang

This hybrid can often be found where P. indica and P. odorata grow together.

P - HiM, Daw, Lng.

C - Lng.

*P. odorata (L.) Cass.

= P. symphytifolia (Mill.) Gillis

Forms dense stands on Christmas in disturbed areas. The specimen collected by Hill in 1949 and reported by Dawson (1959) has been redetermined as X P. fosbergii.

P - Lng.

F - R&T, Wes

C - Gal, Ham, Lng, Jen(K), Gri(K), Sdg(K), Wes.

*Sonchus oleraceus L.

Christophersen (1927) noted it around Cable Station on Fanning.

F - [Bal]

*Synedrella nodiflora (L.) Gaertn.

A common weed in disturbed areas.

P - HiM, Daw, Lng.

W - H&K(UC), Sdg(K), Wes.

F - Bal, H&K(UC), R&T, Wes.

*Tridax procumbens L.

A local population found near Captain Cook Hotel on Christmas Island. May be a recent arrival.

C - Wes.

*Verbesina encelioides (Cav.) B. & H. ex Gray

A volunteer around London village on Christmas.

C - Wes.

*Vernonia cinerea (L.) Less.

A common weed along roadsides and around settlements.

P - Daw, Lng.

W - Ber, H&K(UC), Wes.

F - Bal, Cht, H&K(UC), R&T, Wes.

C - Ber, Wes.

BIBLIOGRAPHY

Anonymous, 1838-41, Log of the USS Peacock, Pacific Manuscripts Bureau
Doc. 773.

-----, 1874-86, Pacific Islands: Arundel, Plant Lists, Tropical Asia,
Australasia and Southern Islands, 1874-86, Volume 14, bound volume of
determination lists in Royal Botanical Gardens, Kew.

----- (Marie-Helene Sacht?), 1962, The Natural History Society
(Christmas Island) and its Bulletin, Atoll Research Bulletin, 94:1-5.

Arundel, John T., 1870-1919, Diary, Pacific Manuscript Bureau
manuscript nos. 480-492.

-----, 1890, Phoenix Group and other islands of the Pacific. New
Zealand Herald, 5 and 12 July, Auckland.

Bailey, Eric, 1977, The Christmas Island story, Stacey International,
London.

Ball, S. C. (n.d.), Field note books, manuscript in the library of the
Bernice P. Bishop Museum.

Bennett, Frederick D., 1970, Narrative of a whaling voyage round the
globe from the year 1833 to 1836, 2. vols., N. Israel, Amsterdam and
Da Capo, New York (facsimile of 1840 edition published by Richard
Bentley, London).

Brown, F.B.H., 1930, New Polynesian plants, Occasional Papers Bernice
P. Bishop Museum, 9:1-23.

-----, 1931, Flora of southeastern Polynesia, Bulletin Bernice P.
Bishop Museum, 84.

Bryan, Edwin H. Jr. 1942, American Polynesia and the Hawaiian chain,
Tongg Publishing Co., Honolulu.

-----, 1974, Panala'au memoirs, Bernice P. Bishop Museum, Honolulu.

Carter, John (Ed.), 1984, Pacific Islands yearbook, Pacific
Publications, Sydney.

Chock, Alvin, 1963, J. F. Rock, 1884-1962, Taxon, 12:89-102.

- and Dean C. Hamilton, 1962, Plants of Christmas Island, Atoll Research Bulletin, 90.
- Christophersen, Erling, 1927, Vegetation of Pacific equatorial islands Bulletin Bernice P. Bishop Museum, 44.
- Dawson, E. Yale, 1959, Changes in Palmyra Atoll and its vegetation through the agency of man, 1913-1958, Pacific Naturalist, 1:1-51.
- English, John, 1857, Letter to William Miller H.B.M. Consul General in the Pacific Ocean, Foreign Office Document, 58/85 Miller No. 14.
- Fosberg, F. R. 1939, Notes on Polynesian grasses , Occasional Papers Bernice P. Bishop Museum, 15:37-48.
- , 1943, Notes on the plants of the Pacific atolls III, a brief summary, Bulletin Torrey Botanical Club, 70:386-397.
- , 1953, Vegetation of Central Pacific atolls, a brief summary, Atoll Research Bulletin, 23.
- Gallagher, M. D., 1960, Bird notes from Christmas Island, Pacific Ocean, The Ibis, 102:489-502.
- Garnett, Martin, 1981, Christmas Island wildlife sanctuary: Information to visitors, Wildlife Conservation Unit, Christmas Island, mimeo.
- Geesink, R., 1969, An account of the genus Portulaca Indo-Australia and the Pacific, Blumea, 17:275-301.
- Greene, Daniel B., 1860-65, Log of the Massachusetts, Pacific Manuscripts Bureau, Doc. 349.
- Gregory, Herbert E., 1923, The report of the Director for 1923, Bulletin Bernice P. Bishop Museum, 4.
- , 1925, The report of the Director for 1924, Bulletin Bernice P. Bishop Museum, 24.
- , 1935, The report of the Director for 1934, Bulletin Bernice P. Bishop Museum, 133.
- Hemsley, William Botting, 1855, List of the plants collected in the Pacific Islands by J.T.Arundel, Report on the scientific results of the voyage of the H.M.S. Challenger. Botany Vol. 1, Part 4, p. 116.
- Herns, William B., 1925, Entomological observations on Fanning and Washington Islands, together with general biological notes, Pan-Pacific Entomologist, 2:49-54.
- , 1926, Diocalandra taitensis (Guerin) and other coconut pests of Fanning and Washington Islands, Philippine Journal Science, 30:243-271.

- Holley, Richard, 1853-57, Log of the Washington, Pacific Manuscripts Bureau, Doc. 369.
- Holtum, R.E., 1974, Asplenium Linn. sect. Thamnopteris, Gardener's Bulletin, 27:143-154.
- Jenkin, R. N. and M. A. Foale, 1968, An investigation of the coconut growing potential of Christmas Island, Directorate of Overseas Surveys, Land Resources Division (Land Resource Study, 4), Tolworth, England, 2 vols.
- Judd, G. P., 1859, Journal of G.P. Judd, Hawaii Mission Childrens Library, Honolulu.
- Hussey, Benjamin R., 1841-45, Log of the James Maurey, Pacific Manuscripts Bureau, Doc. 365.
- Keyte, G.S., 1861, Fanning's Island: An incident, The Friend, 18:31.
- Kondo, Y. and Willian J. Clench, 1952, Charles Montague Cooke Jr.: A bio-bibliography, Special Publication, Bernice P. Bishop Museum, 42.
- Langdon, Robert, 1974, Arundel, the shy Cecil Rhodes of the Pacific Islands, Pacific Islands Monthly, 45:59-61.
- Lanjouw, J. and F.A. Staflen, 1954, Index Herbariorum Part II, Collectors A-D, Regnum Vegetabile 2, International Bureau for Plant Taxonomy and Nomenclature, Utrecht, Netherlands.
- Loomis, Elisha and Maria, 1820-24, Extracts from the journal of Elisha and Maria Loomis, typescript in Hawaii Mission Childrens Library, Honolulu.
- Loomis, Maria, 1820-24, Journal of Mrs. Maria Sartwell Loomis, typescript in Hawaii Mission Childrens Library, Honolulu.
- Luomala, Katherine, 1953, Ethnobotany of the Gilbert Islands, Bulletin Bernice P. Bishop Museum, 213,
- Lucett, Edward, 1851, Rovings in the Pacific from 1837 to 1849, 2 vols., Longman, Brown, Green and Longmans, London.
- Maragos, James E., 1979, Palmyra Atoll: Preliminary environmental survey and assessment, U.S. Army Corps of Engineers, Honolulu.
- Martelli, V., 1926, A new species of Pandanus from Fanning Island, University of California Publications in Botany, 13:145-146.
- Merrill, E.D., 1925, On the flora of Fanning and Washington Islands, Christophersen referred to this manuscript when preparing his study of the vegetation of the Central Pacific atolls and stated that it was on file in the Library of the Bernice P. Bishop Museum. No trace can be found of it there.

- Ministry of Education Training and Culture, Kiribati Government, 1979, Kiribati: Aspects of history, published jointly with Pacific Studies and Extension Services, University of the South Pacific, Tarawa, Kiribati.
- Neal, Marie C., 1965, In gardens of Hawaii, Bernice P. Bishop Museum Press, Honolulu.
- Poelnitz, Karl von, 1936, New species of Portulaca from southeastern Polynesia, Occasional Papers, Bernice P. Bishop Museum, 12:1-6.
- Republic of Kiribati, 1983, Resources Study of Fanning and Washington (Northern Line Islands), mimeographed government report, 63 pp.
- Rock, Joseph F., 1916, Palmyra Island: with a description of its flora, Honolulu Star Bulletin, Honolulu.
- , 1929, The voyage of the Luka to Palmyra Island, Atlantic Monthly, 144:360-366.
- Skerrett, Joseph S., 1873-4, Log of the U.S.S. Portsmouth, manuscript in the U.S. National Archives, Washington D.C.
- Sledge, W. A. 1984, University of Leeds, personal communication.
- Stone, Benjamin C., 1968, Notes on Pandanus in the Line Islands, Micronesica, 4:85-93.
- St. John, Harold, 1952, A new variety of Pandanus and a new species of Fimbristylis from the Central Pacific Islands. Pacific Plant Studies 11, Pacific Science, 6:145-150.
- , 1974, The vascular flora of Fanning Island, Line Islands, Pacific Ocean, Pacific Science, 28:339-355.
- Streets, Thomas H., 1876, Description of a new duck from Washington Island, Bulletin Nuttall Ornithological Club, 1:46-47.
- , 1977a, Contributions to the natural history of the Hawaiian and Fanning Islands and Lower California made in connection with the U.S. North Pacific Surveying Expedition 1873-75, Bulletin of the U.S. National Museum, 7.
- , 1877b, Some account of the natural history of the Fanning group of islands, American Naturalist, 11:65-72.
- Urdike, John, 1973, Pigeon feathers and other stories, Knopf, New York.
- Wentworth, Chester K. 1925, A tropical peat bog, Bulletin Geological Society of America, 36:137.

-----, 1931, Geology of the Pacific equatorial islands, Occasional Papers Bernice P. Bishop Museum, 11.

Wilkes, Charles, 1970, Narrative of the U. S. Exploring Expedition, 5 vols., Gregg Press, Upper Saddle River, New Jersey, (facsimile of first edition published in 1845).