

FLORA OF SOUTHEASTERN POLYNESIA

I. MONOCOTYLEDONS

BY

FOREST B. H. BROWN

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Flora of Southeastern Polynesia

I, MONOCOTYLEDONS

By FOREST B. H. BROWN

INTRODUCTION

SCOPE AND PURPOSE

The Marquesas Islands, although discovered by Mendana in 1595, were not explored until two centuries later. In fact, it was not until 1862 that Jardin (30)¹ published the first and, apparently, the only connected account of the flora of these islands.

In his treatise of the flora of French Polynesia Drake (15) cites those connected with botanical explorations in the Marquesas as follows: J. R. and G. R. Forster (1772-1786), Hombron and Le Guillou (1825-1853), Dupetit-Thouars (1842), Jardin (1854-1862), Savatier (1877), Le Bastard, Mercier, Barclay, Ribbort, Mathews, Langsdorf, and Lapere. Of these, J. R. and G. R. Forster, who accompanied Captain Cook on his second voyage around the world (1772-1775), collected and identified a few plants. More extensive collections and studies are credited to the subsequent explorations of Jardin and Dupetit-Thouars. M. Charles Henry, during his directorship of the Societe Francaise in the Marquesas, was keenly interested in the Marquesan flora. His discovery in 1916 of the rare Marquesan palm, *Pelagodoxa henryana*, is a contribution of outstanding importance to the botanical knowledge of the Marquesas.

During the period from April 16, 1921, to September 27, 1922, as bontanist of the Bayard Dominick Expedition of Bernice P. Bishop Museum,² it was the privilege of the author to spend 17 months in an intensive survey of the Marquesas, visiting all the inhabited islands.

Explorations, made by foot, horse, and canoe, and three long cruises by schooner, were so planned as to observe, in so far as possible, each square mile of land surface at sufficiently close range to determine the leading topographic features and the distribution and gross composition of the plant associations. Cruises by schooner and canoe were of service in determining the coast line features of the large islands and the number, size, location, and vegetation of the smaller islands or projecting rocks. Submerged banks

¹ Numbers in parenthesis refer to Literature Cited, pp. 180-181.

² The organization and personnel of the Bayard Dominick Expedition are described in the Report of the Director for 1920 (B. P. Bishop Mus., Occ. Papers, vol. 8, no. 1, 1921).—Editor.

and areas of shallow water were located, and observations were made upon the navigable waters of the archipelago which are comparatively rich in plankton, green in color, and calm in comparison with the clear blue waters of the surrounding ocean.

In as much as Nukuhiva is not only the richest in vegetation but possesses by far the largest and most fertile valleys in which are best preserved the remnants of the intensive system of native agriculture, a somewhat longer period was devoted to its study than to any other single island. Therefore Taiohae was made the permanent base for the 17-months' survey, and a laboratory was established there for the study and preservation of plant material and photographic records.

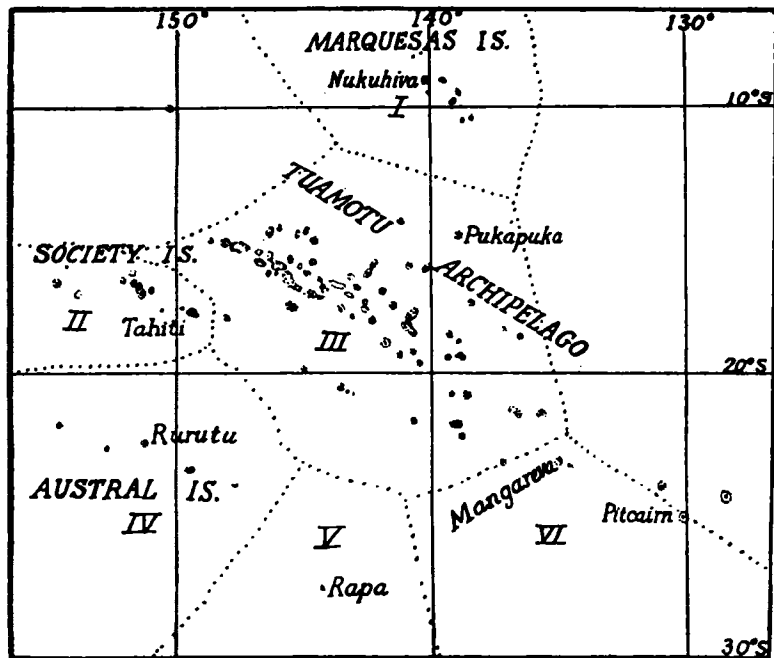


FIGURE 1.—Index map of southeast Polynesia. Floral regions bounded by dotted lines: I, Marquesas; II, Society Islands; III, Tuamotus; IV, Austral; V, Rapa; VI, Oeno-Pitcairn-Henderson.

From the base at Taiohae, the remarkable rain forests of tall tree ferns, woody angiosperms, and herbs of the central crater region (Tovii) were explored, and the first photographs of this not easily accessible region were obtained. Explorations outside this crater region revealed the topography, climatic and soil conditions, and the vegetation of the inhabited and uninhabited valleys and ravines, together with that of the uplands radiating from

the crater rim to the coastal cliffs; the western arid slopes (the so-called desert, known as Fenua Ataha by the natives) are remarkable for their covering of arid grasses, xerophytic shrubs and trees.

During the course of field work the following 33 valleys of Nukuhiva were explored: Hakaea, Pua, Motuhee, Hamatu, Hakaavo, Haopu, Hakiki, Hatuatua, Tapueahu, Hakaoa, Hakateaho, Tataia, Hatepuna, Hakapio, Hahini, Haatite, Temokomoko, Hakapaa, Taipi, Hakauai, Hapaa, Taiohae, Aotupa, Haatiti, Hahiva, Mauu, Hatiheu, Hooumi, Hatuatua, Hataivea, Anaho, Vaionea, Akapani. Of these only 10 (Taipi, Hakauai, Hapaa, Taiohea, Aotupu, Hatihue, Hooumi, Anaho, Vaionea, and Pua) have been permanently inhabited. Taipi Vai (Typee) is by far the largest and most fertile valley in the Marquesas, therefore the most important botanically. One week and two days of exploration were spent there. Like the much smaller valley of Hakauai it is of special importance in the survey on account of the remnants of native agriculture still carried on and the evidence of its much greater extension. Valuable data bearing on the coastal vegetation and topographical features visible from the sea were obtained by a cruise around Nukuhiva at close range, enabling a photographic projection of these features to be recorded (fig. 3).

From Taiohae as a center, expeditions were made to each of the other inhabited islands of the group. The length of time spent in the study of these islands depended partly on the botanical data available and partly on their accessibility. Hivaoa, although the second in size, is not as rich in vegetation as Nukuhiva, and its relatively small valleys did not permit as extensive agricultural development. Also, being the administrative center of the Marquesas, it is in more direct contact with Tahiti. Therefore, the population is more heterogeneous, ethnobotanical information is less authentic, and fewer remnants of the ancient type of agriculture exist. For these reasons a period of about three months proved sufficient for the exploration of Hivaoa. On this island as on Tahuata, Uahuka, Uapou, and Fatuhiva, essentially the same plan of land and shore exploration was followed as on Nukuhiva, except that these islands were not completely circumnavigated. However, the salient costal features were observed, either by boat or by land, in all parts except the northern shore of Uahuka.

On Hivaoa, observations and collections were made in the following valleys: Atuona, Taaoa, Hanamenu, Anahi, Nahive, Puamau, Hanupe, and Taahuku, and on the plateau regions, Ootua and Feani [Keiani]. The two plateau regions proved the richest botanical sections of the island. Of these the cloud zone of Feani is the richer. In comparison with Tovii, of Nukuhiva, it is smaller and lacks the distinctive features of that region.

During the four days spent on Tahuata, the valleys of Vaitahu and Hapaoni were explored; also the cliffs and high altitudes of Vaitahu which

are of special botanical interest, being particularly noted for their sandalwood, excellent samples of which were obtained.

A period of 22 days was given to a study of the flora of Fatuhiva. The western part of the island, particularly the coastal slopes and cliffs, is one of the most picturesque regions in the Marquesas. Over all the leeward area within the crescent of the mountain ridge the climate is humid and the vegetation highly tropical in appearance—a condition which is just the opposite of that observed upon Nukuhiva, Hivaoa, and the other Marquesan islands. In this western region, the valleys of Omoa, Hanau, Otoo, Eeu, Nanitapota, Hanapuea, and Hanavave were studied. Omoa and Hanavave proved of particular interest; valuable information concerning the native plants with their uses and the ancient methods of agriculture was obtained from there. The other valleys were comparatively small and not well supplied with water but the presence of native food plants is evidence of former occupation. The most interesting result obtained during the exploration of the interior was the discovery of an ancient food valley. (See p. 24.)

On Fatuhiva a study was made of the plant life on the previously unexplored Tavaovaho (Tauauoho), the summit of the high mountain ridge separating the eastern from the western part of the island within the cloud zone where conditions are particularly favorable for the growth of epiphytes. So densely crowded is the vegetation that it is impossible to cut a trail through the jungle and for a distance of about two miles it was necessary to walk over the tops of trees, shrubs and other plants. A number of rare plants were obtained. On account of the difficulty of crossing this high mountain ridge, eastern Fatuhiva is isolated, and few others than natives have ever visited it. In consequence, it is one of the best regions for the study of ancient native customs. From observations there is little doubt that a study of this region would yield important ethnological and archeological information.

The valleys of Ouia, Ahou, Tahuapehekua, Naahoanea, Teahiahu were also explored. The mountains of Mouna Natahu, and Mouna Nui, hitherto unexplored, were of special interest, rare and previously undescribed plants occurring there. It was on Mouna Natahu, a mountain extremely difficult of ascent, that *Pelea brownii* F. Brown, new species, was obtained. This plant, which has never before been collected or described, is one of the most famous plants in the ceremonial legends of the Marquesas, revealing a highly interesting, important, and new Marquesan-Hawaiian ethnobotanical connection. It was named in honor of Dr. Elizabeth Brown.

On the island of Uapou, five days were spent in a study of the valleys of Hakahau and Hakahetau, and the interior regions from Potanui to high altitudes.

On account of transportation difficulties, only three days could be devoted

to the survey of Uahuka. During this time the east side slopes of the island and the valleys of Hokatu, Hane, and Vaevae were explored.

In addition to the 17-months' survey of the Marquesas, the period of seven months spent en route to and from the Marquesas afforded opportunities for the observation and comparison of the floras, and the collection of specimens in Fiji, New Zealand, Rarotonga, Mangaia, Raiatea, Tahiti, and the Tuamotus. During the 23-days' cruise through the Tuamotus, the following 18 islands were visited: Arutua, Kaukura, Niau, Rangiroa, Apataki, Toau, Anaa, Faaite, Tahanea, Raraka, Katiu, Makemo, Taenga, Raroia, Takume, Fangatau [Angatau], Fakahina [Fangahina], and Pukapuka. (See fig. 1.) The time spent on these islands ranged from three hours to one day, thus affording ample time for the study of these small low-lying coral islands with the meager vegetation. The data obtained are of value in a comparative study of the vegetation of high and low islands, and lead to new conclusions bearing on the endemism of low altitude vegetation. (See p. 25.) Owing to their small areas and their thin soil, native agriculture on coral islands is not extensive in scope or character. The chief food plant is *Pandanus*.

Including the Marquesas, a total of 34 islands were explored.

This treatise is based upon collections made by the writer supplemented by those of other collectors whose names appear in connection with the types and reference types cited after each description. The discovery of considerable new material in the collections obtained from the islands en route has made it necessary to identify numerous extra-Marquesan species and varieties before the systematic position of close relatives in the Marquesas could be determined. The new data obtained are valuable, not only in connection with the taxonomic phases of the problem, but also in connection with the ecology of the Pacific floras and problems dealing with the migration of the Polynesians. Therefore it has seemed best to extend this treatise to include significant records from the Tuamotus, Austral Islands, and Rapa.

The botanical knowledge displayed by the Polynesians in their study of the anatomy and uses of plants and in their development of an intensive agriculture which supported dense populations in small areas is interesting; but the unexpected and remarkable phase of their botanical knowledge is their system of botanical nomenclature. This appears, beyond question, to be an ancient Polynesian derivative; therefore it may be regarded as a well-preserved remnant of the pre-Linnaean botany of the continent. The Marquesan system of classifying and naming plants is remarkably similar to that of Linnaeus, except that less attention was given to the parts of the flower. The Marquesans employed a binomial system of nomenclature in which the name of the group (Linnaean genus) is followed by an adjective (Linnaean species). The elaborate native trinomial system, which the Marquesans em-

ployed in naming the numerous cultivated varieties and subvarieties of the breadfruit and pineapple, seems not to have been applied to the coconut. Doubtless this was due partly to the fact that the breadfruit was cultivated far more intensively than the coconut or any other plant under native cultivation. Its use in connection with the pineapple was evidently to emphasize the distinction between it and *Pandanus*, with which it was classed on account of the resemblance of the fruit and the spirally arranged, linear, spiny-margined leaves.

ACKNOWLEDGMENTS

Due in large measure to the helpful cooperation and advice of Mr. George S. Waterhouse of the Bank of Bishop in arranging the financial details of the expedition, the most favorable consideration and hearty cooperation of the banks of New Zealand and Tahiti were obtained. Thanks are due Mr. Charles Moritzson of New Zealand for suggestions, advice, and letters of introduction to leading business men of New Zealand; Mr. E. H. Little of Auckland, New Zealand, for aid and advice in the selection and purchase of supplies for the expedition; the customs officials of New Zealand for their courteous exemptions of duty. To the Union Steamship Company, through its officers, Captain Bilton and Chief Officer Gray, the writer is greatly indebted for information and facilities provided for visiting the islands en route to Tahiti.

As a result of the kindness and hearty cooperation of the following scientists, the 86 days spent in New Zealand, owing to delays in transportation, were profitably spent in field studies proving of special importance in comparative work with the flora of the Marquesas: the late T. F. Cheeseman, Curator of the Auckland Museum; Professor H. P. Kirk of Victoria University College, Wellington; Captain L. MacIntosh Ellis, then Director of the Department of Forestry; Secretary E. Philips Turner, now Director of the Department of Forestry; Dr. Charles Chilton, then Professor of Biology at Canterbury College. Valuable advice and suggestions concerning native names and uses of Polynesian plants in New Zealand, which subsequently proved highly stimulating in a similar study at the Marquesas, were supplied by Mr. Elsdon Best of the Dominion Museum at Wellington, and Te Rangi Hiroa (Dr. Peter H. Buck) then Director of Maori Hygiene.

The time spent in the Society Islands (38 days) was made profitable from the botanical standpoint through the helpful assistance of the following: the former American Consul, Mr. Charles Wythie; the late Mr. Orsmond Walker; Mr. J. Frank Stimson; Mr. Louis Drollet; Chief Tefata; and Mrs. Levard.

Every facility was afforded for visiting islands during the 22 days en

route through the Tuamotus to the Marquesas, by the kindness of the late Captain Joe Winchester of the *Tahitian Maiden*.

The writer desires to express his thanks to the following whose friendly and helpful cooperation, collection of specimens, information concerning native uses and names of plants contributed to the success of the expedition in the Marquesas: M. G. de Poyen Belleisle, the executive administrator of the Marquesas, whose permission granting the use of the government buildings at Fatuhiva and Uapou and other kindnesses financially aided the work; M. Charles Henry, at that time Director of the Société Française, through whose friendship and untiring interest every effort was made to facilitate the work and add to the comfort and pleasure of the party, and as whose guest the author was able to make a prolonged stay in Taipi Vai and to circumnavigate the island of Nukuhiva; Pere Simeon Delmas, for his kindly interest in the work and the donation of many specimens; Mr. Frank Varney, M. Alfred Berard, and Mr. Henry Lee, for courtesies shown during the author's sojourn in Hivaoa; Captain Philippe Michellie of the *Commodore*, who generously donated transportation from Fatuhiva to Hivaoa and Uapou, and fine specimens of *Santalum* from Tahuata; Mr. Samuel Kekela and M. Tissot of Uapou; Chief Tametona of Omoa, Fatuhiva; Mr. and Mrs. George Sterling and the late Mrs. Gertrude M. Fisher, whose friendship, kindness, and information concerning the native uses of Marquesan plants are greatly appreciated.

To the many native Marquesans, the list of whose names is too long for publication, especially Francois Taupotini, his brothers and sister—the surviving members of the family of the late King Moana Tini and Princess Vaikehu of Nukuhiva—and Haketau, one of the few remaining Taipis, the writer is deeply indebted for the generous sharing of their wonderful knowledge of the native plants. For their sympathetic interest in the work, for their sacrificing efforts to aid the explorations, and for their hospitality to the "stranger within their gates" thanks are inadequate. One can only say *kaoha nui*.

Acknowledgment is especially due to Dr. Elizabeth Brown, who voluntarily contributed to the field studies throughout the two years of the survey, the subsequent researches, and the preparation of the manuscript, including the detailed study of the native names and uses of plants.

GEOGRAPHY OF THE MARQUESAN ISLANDS

TOPOGRAPHIC FEATURES

The Marquesan islands from which plant collections were obtained are nine in number: Hututu, Eiau, Moutane, Nukuhiva, Uahuka, Uapou, Hivaoa, Tahuata, and Fatuhiva. All except the first three are inhabited. Of these, the largest, Nukuhiva, is not more than one-fourth of the area of Oahu, Hawaii. The nine islands, together with numerous lesser islands,

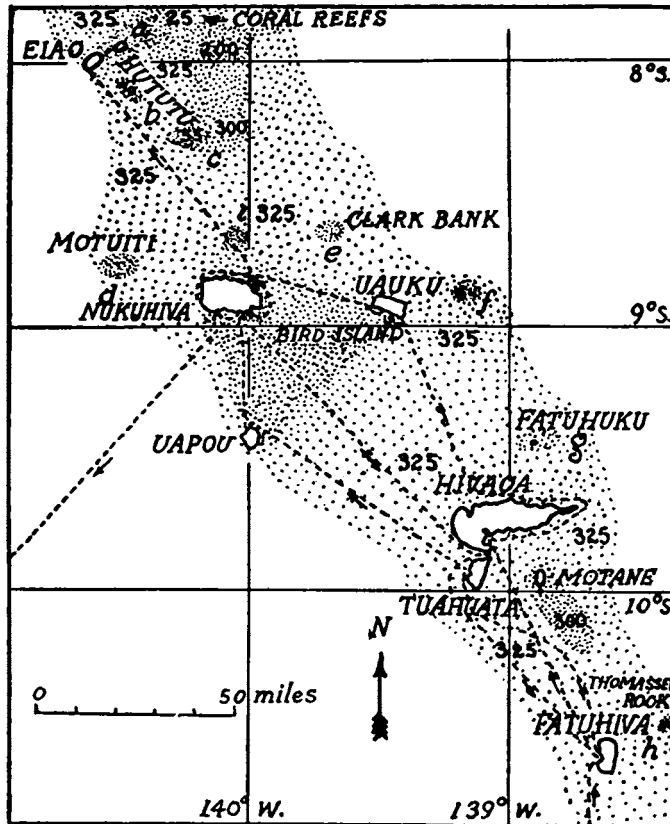


FIGURE 2.—Map of the Marquesan Archipelago showing islands from which plant collections were obtained, and available soundings recorded in meters: *a-i*, nine areas of less than 100 meters, four of which (*d, g, h, i*) are rocks or small islands surrounded by shallow water. With an emergence of 100 meters, not less than six islands (*a, b, c, e, f, i*) would be added to the archipelago; with 325 meters emergence large land areas would appear at *a, c*, and southern Moutane; with 400 meters emergence all islands would apparently unite into one land mass, or nearly so. Dotted lines indicate routes of travel.

exposed rocks, and submerged banks of which the archipelago is composed, are grouped in an elongated elliptical area extending from northwest to southwest, between latitudes $7^{\circ} 50''$ and $10^{\circ} 35''$ S., and longitudes $138^{\circ} 25''$ and $140^{\circ} 50''$ W. This places them in the same latitude as southern Java and central Brazil.

The topography of the Marquesas is characterized by a number of exceptional features. The surface of the six inhabited islands is mountainous, ranging approximately from 800 to 1200 meters in altitude as follows: Uahuka, 800 meters; Tahuata, 1000 meters; Fatuhiva, 1100 meters; Hivaoa, 1100 meters; Nukuhiva, 1200 meters; Uapou, 1200 meters. From these figures it is apparent that uniformity of altitude is a characteristic feature of the Marquesas in comparison with that of the somewhat similar dissected type as that of the Society Islands, Fiji, Cook Islands, Hawaii, and other volcanic islands of Polynesia. The altitude is nearly the same as that of Oahu, Hawaii, and Moorea, Society Islands; it is considerably less than that of Tahiti and greater than that of Raiatea or Rarotonga. In proportion to their area, however, the islands of the Marquesas are higher than those of other Polynesian archipelagoes. Chubb (12), in his interesting treatment of the geology of the Marquesas, concludes that the elevation was at one time not less than 600 feet greater than at present—an assumption quite in accord with the botanical evidence. However, the fact that widely separated relics of a cold-climate vegetation still persist in some of the islands, as previously shown (8), indicates that the former altitude was 1000 to 3000 meters higher than at present.

Another topographic feature which is characteristic of the inhabited Marquesan islands, is the comparatively level surface at high altitude. This may be observed in Fatuhiva, Hivaoa, Uahuka, Uapou, but is most marked in Nukuhiva. Chubb accounts for the flat summit of some of the islands on the assumption that they were originally submerged, permitting the formation of plateaus by marine planation. His illustration (12, fig. 10), however, exaggerates the flatness of Nukuhiva, which, according to the writer's observation, is a low truncated cone (fig. 3), with a crater-like subcircular summit approximately 5 miles in diameter. And while it is not improbable that the summit was submerged, it seems impossible that the truncation is the result of wave action; for the edge, except where cut away by streams, is an elevated rim approximately 200 meters in height, and the enclosed plane is concave. Had it been formed by wave action, the edge would be lower than the center and the surface would be convex instead of concave. The elevated rim, concave floor and the presence of what appear to have been crater lakes, now filled with marsh or swamp vegetation, suggest that this basin area is a former crater of enormous size, resembling, in essential respects, the much smaller inactive crater known as Punchbowl, of Hawaii.

Although this crater area of Nukuhiva has no inhabitants and there are no evidences to indicate that it has ever been inhabited, it is mentioned in the native legends and traditions as *Tovii*, and is famous throughout the archipelago. In ancient times it served as the battle ground of the tribes of Nukuhiva, and the sling stones covering the ground testify to the numerous battles fought there. Crudely made stone tikis appear in places. According to the natives, a few breadfruit trees and some wild taro were planted by conflicting tribes. It was here that the far-famed *Petavii* banana, prominent in traditions, is said to grow, though none are to be found there now. At the present time, dangerous herds of semiwild cattle and still more dangerous semiwild pigs feed upon the luxuriant vegetation of the rain forest, and very likely have consumed the food plants formerly present. (See p. .)

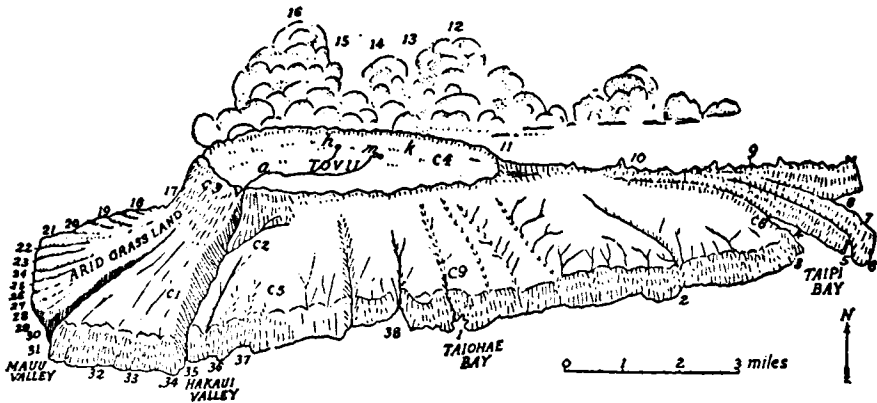


FIGURE 3.—Sketch diagram of Nukuhiva: *c 1-c 9*, botanical stations; *c 3*, Anaonihi caves; *c 4*, Tuamakaka caves; *c 9*, central station and botanical laboratory at Vaitu, Taiohae; *a*, Lake Hakameama; *h*, Lake Henry; the cascade of the Great Eel (*Teua-kueenui*), head of Taipi Valley; *m*, Mokuautoto; Vaipo Cascade, head of Hakaui Valley: 1-37, coastal localities; 1, Taiohae; 2, Tikapo; 3, Hakapaa; 4, Taipi; 5, Hooumi; 6, Cape Martin; 7, Neva; 8, Haatuatua; 9, Hataivea; 10, Anaho; 11, Hatiheu; 12, Haume; 13, Vaionea; 14, Aakapa; 15, Akapani; 16, Hakaea; 17, Pua; 18, Motuhee; 19, Hahinaani; 20, Hamatu; 21, Hakaavo; 22, Haopi; 23, Hakiki; 24, Hatuatua; 25, Hakaoa; 26, Tapueahu; 27, Hakateahu; 28, Tataia; 29, Hatepuna; 30, Hakapio; 31, Mauu; 32, Hahine; 33, Haatiti; 34, seven salt caves in cliffs; 35, Hakatea; Hakaui at *c 1*; 36, Uauka; 37, Teahioa; 38, Aotupa.

No horses are found because they will not voluntarily climb into this region, but must be aided and forced by the natives. The absence of goats, according to native informants, is due to the fact that the pigs devour the young goats.

In all inhabited Marquesan islands, deep ravines radiate from the region of central high plains, ridges, or peaks, where the heavy rains occur. A cloud cap forms each day over the interior altitudes of each island, beginning about 7:30 a. m. and soon obscuring the summit of the high peaks and ridges.

The cloud cap of Uahuka, the lowest one of the inhabited islands, is less clearly defined than that of the others.

Due partly to the influence of erosion and weathering, conspicuous irregularities of contour are formed in the surface topography. Uapou, in particular, is distinctly characterized by its remarkable cone-shaped spires of hard rock, projecting far into the overhanging cloud cap and visible for a distance of over 30 miles. In Fatuhiva, a large circular opening through the high central ridge is plainly visible from the Omoa-Hanavave trail, and from certain positions at sea.

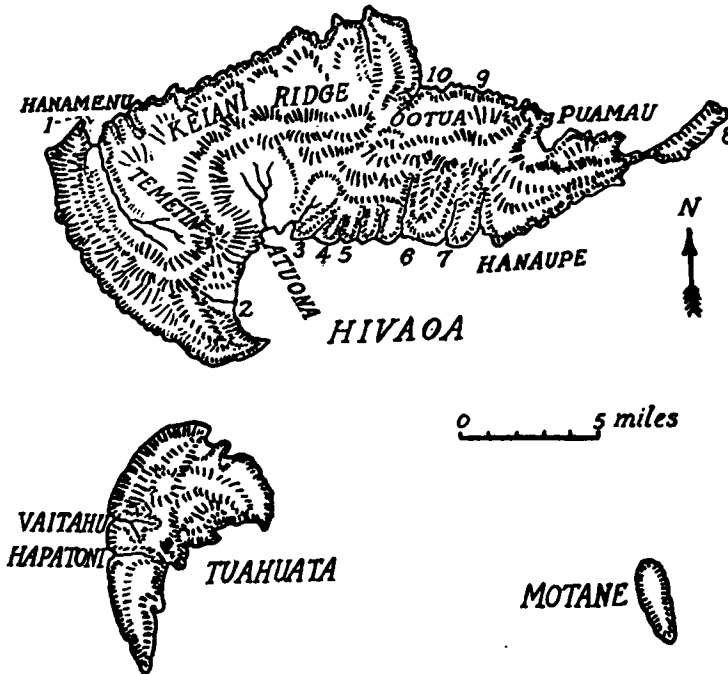


FIGURE 4.—Sketch map of Hivaoa and Tahuata (Tuahuata) showing principal valleys explored. Coastal localities: 1, Hanaheka; 2, Taaoa; 3, Taauku; 4, Punaci; 5, Hanamate; 6, Hanatea; 7, Hekeani; 8, Matafenua; 9, Nahoe; 10, Hanahi. The main precipitation is on Timetiu (Temetin), Feani (Keiani), and Ootua, where the indigenous vegetation is especially well preserved.

The relatively dry uninhabited islands from which plant collections were also obtained range in height as follows: Eiao, 600 meters; Moutane, 500 meters; Hututu, 400 meters; Fatuuku, 300 meters; Motuiti, 220 meters. Bird island, East Sentinel, West Sentinel, and numerous lesser islands or projecting rocks form parts of the archipelago. Small coral islands or reefs and shifting bars of sand are reported in the shallow northern extension of the archipelago. The surface of bare rock or thin soil projecting above wave

action is protected by an arid vegetation composed largely of indigenous grasses. Swarms of sea birds nest among the tussocks of grass, affording, at certain seasons, an abundance of eggs for food.

The coast line topography of the Marquesan Islands is strikingly different from that of any other group in oceanic Polynesia, due to the almost complete absence of coral reefs. The surf drives with unbroken force upon an unprotected coast, cutting away and undermining the soil and rock of the shore. Surf erosion, combined with simultaneous submergence of land, as shown in a previous paper (8), has resulted in the formation of perpendicular coastal cliffs 30 to 1000 meters in height, instead of a coastal plain such as that of Tahiti, Rarotonga, Hawaii, and Fiji. Highly characteristic plant associations have developed in relation to this peculiar coastal topography. (See p. 48.)

In the vicinity of Taiohae, the bluffs are composed of black or brown volcanic rock with broad dikes of light-gray. Also, at several localities along the western coast of Nukuhiva, cliffs of light-gray or almost white rock are found. Many striking peculiarities of shape may be observed in these eroded cliffs. The castle-like peaks on the west side of Hatiehu Bay, the two statue-like rocks at Atupa Atua, known as Maa-ha-ke-tevi (Twins of Tevi) or Adam and Eve, a castle-like pile of rocks famous in the legends as Haa-popo-a-tupa, and the giant lizard near Taiohae are some of the prominent landmarks along the coast of Nukuhiva. The columnar rocks at the entrance of Hanavave, Fatuhiva (Bay of Virgins) lend a beauty and picturesqueness unsurpassed by any other island group of Polynesia.

Large caves appear in the face of high cliffs in Nukuhiva. Among those best known to the natives are the seven salt caves at high altitudes in the almost inaccessible slopes at the west side of Hakau Bay, where sodium chloride occurs deeply imbedded in the rocks, through which water filters or collects by the hygroscopic action of the salt and drips from the roof of the caves forming large white stalagmites and stalactites. One of the caves explored is 30 meters broad, 10 meters deep, and 10 meters high. No salt caves of this kind were found on Hivaoa or other islands of the Marquesas.

It is indeed a remarkable fact that all these salt caves are approximately 300 meters above the possible reach of spray or wash from the sea, in the seaward face of the precipitous cliffs, 500 meters in height, of Nukuhiva. Chubb's theory of the submergence of these islands followed by emergence may account, in part, for the impregnation and deposit of salt in the rocks. If imbedded in deep, protected pockets and subsequently exposed by the breaking away of the protecting rock, occasioned by the rapid inundation of the present wave action, it seems reasonable to suppose that caves could be formed by the rapid weathering of the salt.

The ancient Nukuhivans obtained their supply of salt from these high altitude caves; in other islands the natives obtained salt either from the shore or by the use of sea water. However, native traditions state that the Hivaoans made trips to Nukuhiva for the express purpose of obtaining salt from these caves. This would seem to indicate either a scarcity of salt in the other islands or a superiority of the salt obtained from the caves of Hakau.

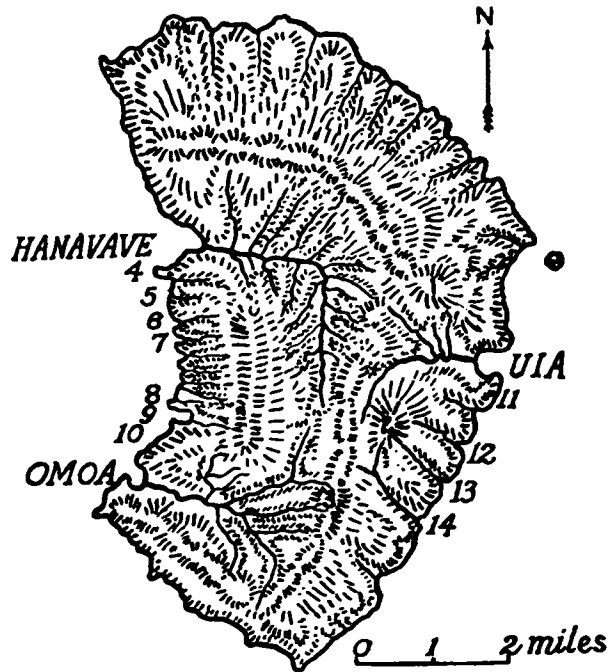


FIGURE 5.—Sketch map of Fatuhiva: 1, Mouna Nui; 2, Mouna Natahu; 3, Tauauoho ridge; 4-14, coastal localities; 4, Hanapuaca; 5, Nanitapota; 6, Tetio; 7, Tomouutea; 8, Ecu; 9, Otoi; 10, Hanau; 11, Ahua; 12, Haahoana; 13, Teahiaho; 14, Tahuapehe Kua. The area east of the central ridge is arid to semi-arid; that west of the ridge has heavy rainfall.

No salt has been found in other caves located at high altitude in the interior of Nukuhiva, such as the caves of Anaonihi and of Tuamaka located in Tovii. These dry caves have always afforded welcome shelter to the natives from the cold and the incessant rains prevailing in this botanically rich but uninhabited region. Small caves in the overhanging cliffs in Hakau Valley, Nukuhiva, served as burial places in ancient times.

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SOIL

The soil derived from volcanic rock is shallow, clay-like in texture, and commonly dark-brown or red in color. Along the trail between Taiohae and Hakau, Nukuhiva, and the high ridges of Feani, Hivaoa, are sterile areas of light-gray claylike soil, which are exceedingly slippery to walk upon when wet. Black humus is formed in the fertile valleys; also a shallow deposit of peat is formed in the marshes and boggy areas of Tovii, Nukuhiva.

In most parts of Tovii, the central and western crater-like area of Nukuhiva, the surface is level, and the soil remarkably free from stones or boulders. It is one of the very few places in the Marquesas sufficiently level to permit the construction of roadways. In all probability, this basin would prove profitable for the growing of pineapple and sugar cane, providing it is found possible to build roads or trails along the almost inaccessible slopes leading to it.

The soil of the extensive semiarid grass region, in Mauu and other parts of extreme western Nukuhiva, is shallow and stony. Goats and wild cattle in large numbers browse on the xerophytic and mesophytic grasses composing the vegetation. Also a few semiwild pigs, cats, dogs, and horses roam over this region.

Considerable deposits of fine dark colored sand are silted along the bottom and washed up on the shores of all the bays. It is composed of the usual minerals found in sand derived from disintegrated volcanic rock, that from Taiohae consisting of black basalt, volcanic ash, crystalline gypsum, and a small amount of olivine. The distribution of bay soils is well shown in a photograph by Pidgeon (33) of the sand bar at the mouth of Taipi Vai (Pl. XXXIV).

In certain localities, notably along the northeast side of Taiohae Bay, Nukuhiva, a small quantity of yellowish white coral sand is deposited on the shore. The composition is similar to that found in Tahiti and Hawaii, where comparatively large deposits occur.

ISOLATION

The mountain flora of the Marquesas is isolated by a distance of approximately 700 miles from that of the nearest high islands. Although the Tuamotus bridge the interval between Tahiti and the Marquesas, they contribute little to the interchange of species due to the fact that, with few exceptions, mountain species cannot grow on coral islands and, conversely, coral island species cannot grow in the rain forest of the high islands. A few Tuamotuan species are, however, invading the low semiarid slopes of the Marquesas. Botanical evidences indicate that the Tuamotus were at one time mountainous, with sufficient areas at high altitudes for the preserva-

tion of an extensive mountain flora, from which, in large part, that of the Marquesas and Society Islands has been derived. The close affinity between related species in the Marquesas and the Society Islands may be explained on this assumption.

FEATURES OF THE SEA

The shores of the Marquesas slope abruptly to deep water in nearly all places except the bays. This was clearly shown in a cruise of Nukuhiva, when a large schooner was able to circumnavigate this island at sufficiently close range to permit the identification of trees and shrubs by the writer.

Notwithstanding the fact that there are no less than nine localities in the archipelago where the water is not more than 100 meters deep, there seem to be no evidences of a submerged beach until a depth of 300 meters is reached. At this level, a long shelf extends south from Moutane and another eastward from the shoal marked in figure 1. A third small bench lies south of Hututu. According to native informants, small coral islands and patches of more or less shifting sand lie at or near the surface within a large area of less than 200 meters. The late Captain Winchester reported nine fathoms at a point just south of Clark Bank and shallow areas between Nukuhiva, Uahuka, and Uapou. Available soundings in other parts of the archipelago indicate extensive areas at 325 meters.

Apparently, an emergence of 100 meters would cause land to appear at six places (fig. 2, *a, b, c, e, f,* and *i*); an additional emergence of 300 meters would unite or bring into close contact all land areas of the archipelago. Obviously this would facilitate the intermigration of species and thus account for the uniformity of plant distribution throughout the Marquesas, particularly between Eiau and Nukuhiva, which have many species in common although separated by a distance of approximately 60 miles. However, an emergence of 300 meters seems insufficient to account for the presence and wide distribution of the relics of a cold climate flora, which now appears on the verge of extinction. Botanical evidences, outlined in an earlier paper (8), indicate that the islands were at one time 1000 to 2000 meters higher than at present; although it seems unlikely that the high altitudes of the Marquesas were of long duration, in as much as none of the high altitude species remaining bear any indication of a long evolutionary history in the archipelago. There is no evidence at hand to suggest that the period of high protuberance extends farther back than the Tertiary. That land submergence, rather than surface erosion, has been the leading factor in reducing the altitudes is suggested partly by the researches of Wentworth (46, pp. 52-57), who finds that surface erosion in the volcanic island of Lanai of the Hawaiian Archipelago may progress at the rate of only one foot in 5000

years, and partly by the comparatively level and apparently primitive crater-like topography of the Tovii region of Nukuhiva, where the cold climate relics now occur; in other words, surface erosion has not yet progressed far enough to wear away the crater which forms the summit of the island.

That submergence is now in progress throughout the archipelago is plainly indicated by the fact that the bays are drowned valleys. (See Pl. XXIV.) The bottom of these bays dips gradually from the shore to the mouth, where soundings of 50 to 100 meters have been recorded.

Ocean currents flow slowly in a generally westward direction, carrying bits of seed-bearing drift to the bays. Tidal waves are of frequent occurrence. Their force is so great that sailboats at anchor in the bays have been landed on dry land in the valleys hundreds of feet from the shore. It is obvious that floating seeds of seed-bearing drift, which would otherwise be buffeted about by the surf, would be landed on fertile slopes and plains of the interior by this means. The isolated occurrence of such plants as *Diplothemium* in Hakau Valley, and *Pelagodoxa* in Taipi valley may be explained on this assumption.

The color of the sea throughout the archipelago is deep-green, instead of blue, as prevails in neighboring regions of the Pacific. As previously shown (8, pp. 115-116), this may be due to the fact that the surf is rapidly cutting away the land taking into solution nutrient materials favorable for the growth of marine plankton. The temperature of the sea water tested in Taiohae Bay is not much lower than the mean of the warm land breeze.

DRAINAGE

The water from the heavy rainfall of the Tovii region in Nukuhiva is discharged from the edge of the basin in not less than five cascades of over 2000 feet in height. These wear away the rock at the base, forming deep pools at the head of Taipi River and Hakau River, the two principal streams to receive the drainage from Tovii. Vaipo cascade, at the head of Hakau River is mentioned by Jardin (24, p. 6), who states: "C'est au dire des géographes, la seconde cascade du monde pour l'élévation." This cascade, the waters which feed it, and the resulting river which flowed from it, were of such interest to the natives that they were named. The waters feeding the cascade were known as Hakameama, Vaitahuna, Taitaiao, Vaihuoi, and Keheupuha. The parts of the cascade were: (1) Vaipo, the top of the cliff from which the falls descend; (2) Vaiheuu a pu toka, the region of the cascade where the roar was loudest, and the place, according to native tradition, where the spirit of man was created; (3) Ahuu, near the foot of the falls and the beginning of the river. The pools and places in the part of the river near the cascade also had names: (1) Vai ta ku etu, (2) Vai kota hae,

(3) Va okape, (4) Vai patu, (5) Vai utu, (6) Vai haa tu papa. The descent into the pool known as Vai haa tu papa was very abrupt, and there, in ancient times, water sports were indulged in, one of which resembled somewhat the Hawaiian surfboard riding. Contests were held, the contestants sliding down into the pool and struggling with one another in an effort to win.

The Cascade of the Great Eel (Teua Kuee Nui) at the head of Taipi Valley is so called from the fact that an enormous red eel, approximately five feet in length and eight or ten inches in diameter, still lives in the deep pool at the foot of this waterfall. It will come to the surface if food, such as bread or fish, is tossed into the pool. Famed in the native tradition, no native Marquesan will harm it. This eel is the only one of its kind in the islands. Tradition states that at one time another lived in Fatuhiva, whose disappearance is accounted for by the legend of the treachery of the Nukuhivan eel, who lured the Fatuhivan one to visit it, on the promise of a generous diet of sweet-smelling flowers, and thereupon devoured the Futuhivan eel.

Taipi River is the largest stream in the Marquesass and one of several which has never been known to become dry. Though 300 feet wide it is too shallow for navigation. A broad sandbar at the mouth makes it difficult to enter even with a canoe. The water of this and other streams is clear, except during heavy rains; it is soft and has a mean temperature of 76° F.

Several ponds or small lakes, 7 to 30 meters in length, occur in the Tovii basin. A new one, discovered by the writer was named by permission of M. Poyan, the President administrator of the Marquesas, "Lac Henry" in honor of M. Charles Henry. Moku-au-toto is evidently a former lake which has been filled in with the peat-like decay of invading vegetation. (See p. .)

Springs of clear mineral water, having an agreeable taste resembling carbonated drinks, are found in the region of Taiohae, Nukuhiva. A spring of cool fresh water, with a temperature of 66° to 67° F., flows from a rock crevice at high altitude, along the Feani trail, Hivaoa. Another cool spring near the bay at Hanamenu supplies ships with soft water.

CLIMATE

LIGHT, TEMPERATURE, AND WINDS

Open situations along or near the shore are exposed to intense light. The interior rain forest regions are shaded by the cloud cap formed each day at an elevation of 700 meters, reducing the light until an intensity of only two to nine per cent of that at the shore is recorded by an actinometer. Regions over which the cloud cap does not ordinarily extend, such as the

arid grassland of western Nukuhiva, are exposed to a light intensity nearly equal to that of the coast.

The inhabited valleys are at times uncomfortably warm during the middle of the day, when the temperature ranges from 82° to 94° F. The nights and early mornings, however, are remarkably cool in valleys such as Taiohae, where the night temperature ranges from 64° to 84° F. This is due to the land breeze, which begins about 9 p. m. and lasts until 7 a. m., bringing cool air from high altitudes in the mountains. As a result, the nights in these places are considerably cooler than in Papeete, Tahiti, or in Honolulu during the summer.

There is a surprising fall in temperature with increase in altitude. Natives and others who visit Tovii (800 to 1000 meters in altitude) suffer with the cold, especially at night. No records of the night temperature at this altitude were obtained, but the day temperature ranges from 61° to 77° F. at times when that of the inhabited portion of the valleys is 82° to 94° F.

Trade winds varying from east by southeast (April to October) to east by northeast (October to April) rarely blow with sufficient force to form white caps on the waves. At the crests of ridges, however, such as the pass between Omoa and Ouia, Fatuhiva, the winds commonly have considerable force. In no inhabited valleys visited is the warm sea breeze prevailing during the day not followed by a more or less cool land breeze from the mountains. Cyclones occur at intervals, one of which was observed on August 20, 1921, between Uapou and Nukuhiva. A column of water with an estimated diameter of 40 feet was carried to great height. Six months later a second cyclone was observed in the same region.

Electric storms seldom occur, which seems rather remarkable from the fact that they are common in Tahiti.

RAINFALL AND PLANT SUCCESSION

In the Marquesas the trade winds passing over altitudes of 800 to 1000 meters are cooled 15° to 25° F., with the result that regions of heavy rainfall exist in every inhabited island, enough rain falling throughout the year for the conservation of a rich rain-forest flora. On Nukuhiva and Hivaoa, the main precipitation is on the windward (eastern) side at high altitudes, the leeward (western) end of these islands being relatively dry. On Fatuhiva, however, the leeward (western) side of the mountain ridge receives the main precipitation, the windward (eastern) side of the ridge being dry. In consequence, a remarkably luxuriant vegetation of rain-forest associations covers the western side of Fatuhiva from the shore line to the highest altitudes and passes abruptly on the eastern side of the ridge into a vegetation decidedly arid in character.

By far the largest area of arid vegetation in the Marquesas is found on the leeward (western) end of Nukuhiva, extending along the gradual westward slopes, which reach from Tovii to the western shore line. This entire area is covered by low prairie with scattered trees and shrubs and thin groves of trees in the shallow ravines, resembling, in essential respects, the prairie in parts of the great plains of the mainland. (See Pl. XXII.) There is, however, no true desert here or elsewhere in the Marquesas, as recorded in some of the maps and published descriptions.

The entire Tovii plateau of central Nukuhiva receives heavy precipitation and is covered with luxuriant rain forest with open areas of matted fern (*Gleichenia linearis*). However, the surface is well drained by numerous streams, with the exception of a few small areas which have evidently been crater lakes and are now covered with marsh (Pl. XXXV). Therefore the statement of Jardin cited by Chubb (12, p. 18): "Le point central de l'isle, Tovii, consiste en une surface de terrain marecageuse" conveys an erroneous impression of the drainage and vegetation of this region. Nor do the conditions observed bear out the impression gained by Handy (17, p. 7), that "Nukuhiva is wet on its eastern section while all the western plateau is practically desert."

Uapou, one of the highest as well as one of the smallest of the inhabited islands, doubtless receives as much rain in proportion to its size as Nukuhiva, which lies in essentially the same relative direction with respect to the trade winds. This is indicated by the presence of extensive rain-forest associations in the wet central altitudes of the islands, over which a heavy cloud cap is formed each day; by the prolific breadfruit trees in the valleys; and by the perennial streams emptying into the bays. However, the vegetation does show marked local variations in different parts of the windward and leeward sides of the island. Approaching the mouth of the valley of Hakahau on the northeastern (windward) side, the semiarid vegetation, barren sand dunes, xerophytic grasses covering the seaward faces of the cliffs, and the confinement of the coconut plantations to the lower areas give an impression of aridity. As stated by Handy: "Uapou is the driest of all the islands, its rain being cut off by Hivaoa, Tahuata, and Fatuhiva." In this respect, Hakahau differs from the valley of Hakahetau on the northeastern (leeward) side of the island and resembles Ouia, Fatuhiva. Both are remarkable for their aridity, although they are located on the windward side of each island respectively.

Although Uahuka is the lowest and therefore probably the driest of the inhabited islands, the rainfall is sufficient to preserve remnants of a rain forest along its interior crests and peaks. The windward slopes leading to the coastal cliffs receive sufficient rainfall for the luxuriant growth of such mesophytic grazing grasses as *Dactyloctenium aegyptiacum*.

If it is true, as all evidences seem to indicate, that altitudes throughout the Marquesas are being appreciably reduced by submergence of land and surface erosion, then it is clear that the climate of the inhabited islands is gradually becoming warmer and more arid and that regions favorable for cold-climate associations and rain forests must be decreasing in area. At least five successive climatic zones may be distinguished in order as follows:

1. High altitude, cold-climate vegetation, characterized by *Cladium nukuhiense* (Pl. XIII, A), *Gahnia*, *Carex tahitensis*, *Dianella*, *Astelia*, *Habenaria*, *Freycinetia*, *Weinmannia*, *Cheirodendron*, *Cyathodes*, *Vaccinium*, *Lycopodium cernuum*. Only relics of this vegetation now occur.
2. Rain forests, composed of tall tree ferns and angiospermous trees, are characterized by the luxuriant growth of epiphytes (lichens, mosses, liverworts, *Hymenophyllum*, *Trichomanes*, *Acrostichum spicatum*, *Lycopodium phlegmaria*, *Peperomia*, *Procris*, *Liparis*) and an undergrowth of ferns, broad-leaved species of *Cyrtandra*, *Lobelioideae*, *Piper*, *Crossostylis*, *Alstonia*, *Pipturus*, and *Boehmeria*.
3. Mesophytic forest, characterized by *Hibiscus*, *Pandanus*, *Zingiber zerumbet*, *Ceodes*, *Wikstroemia*, *Metrosideros*, *Santalum*, *Celastrus*, *Alphitonia*, *Terminalia*, *Campylotheca*, *Premna*, *Celtis*. This zone extends down from the rain forest along the mesophytic slopes into the valleys. The clearings are occupied by *Gleichenia* (creeping fern), *Paspalum conjugatum*, and *Miscanthus japonicus*.
4. Semiarid forest, characterized by *Myroxylon*, *Pelea*, *Sapindus*, *Dodonaea*, *Guet-tarda*, *Plectronia*, *Ficus marquisensis*, and *Casuarina*. This forest covers semiarid slopes, especially the shallow ravines and mild slopes of the semiarid grass belt in western Nukuhiva, western Hivaoa, and eastern Fatuhiva, and extends downward, in certain localities, along the grass covered slopes of the coastal cliffs.
5. Arid and semiarid grassland associations, characterized by endemic species and varieties of *Pennisetum* and *Eragrostis*, and *Aristida subspicata*. These grasses cover the coastal cliffs, the arid slopes of western Nukuhiva, and many of the smaller islands of the archipelago. The tall reedlike *Miscanthus japonicus* forms an almost impenetrable growth in extensive areas of the arid slopes of eastern Fatuhiva.

The highest, coolest, and wettest areas of Fatuhiva, Uapou, Hivaoa, Tahuata, and especially Nukuhiva still preserve the relics of what was, in all probability, an extensive cold climate vegetation. Extensive rain forests are being replaced, as the rainfall is diminished, by mesophytic species. Semiarid trees, shrubs, and grasses predominate on the arid slopes and on the dry coastal cliffs, but form only a subordinate part in the total vegetation.

Uahuka, the lowest of the inhabited islands, may represent a later stage of submergence and erosion, in which the remnants of a rain forest are still preserved. Mesophytic associations predominate, but are being replaced by a succession of semiarid trees and, finally, grasses.

Moutane, Eiau, and Hututu may be considered as the islands in which the altitude, and therefore the rainfall, is so reduced that semiarid trees and grasses predominate.

The numerous small islands, including Bird Island, two Sentinels, and Motuiti, may represent a final stage of submergence, in which the semiarid associations predominate. The soil is too dry and shallow for trees and

shrubs, which are more or less replaced by endemic grasses, affording a favorable nesting place for sea birds.

According to native informants, periods of famine, extending over one or more years, have occurred at irregular intervals. The stem structure of food plants and native trees, however, fails to reveal marked periods of retarded growth, such as prolonged drought would be likely to cause. It is not impossible that the famines are caused by comparatively slight fluctuations in environmental factors during critical stages in the fruiting of the breadfruit, the leading food plant of the ancient Marquesans, which seems fully as sensitive to environmental conditions as many other heavily yielding crop plants, such as the cherry, apple, and cereals cultivated by European races.

RELATIVE HUMIDITY

Notwithstanding the ample precipitation in the Marquesas, the climate is not humid, except during occasional intervals of prolonged rains. The relative humidity of the daily sea breeze as well as the nightly land breeze is so low that the natives are able to dry and preserve meat by cutting it into strips and hanging it from poles along the shore of the bays. This method is now utilized on a large scale to dry copra, by far the leading commercial export of the Marquesas.

SEASONS

There is but slight seasonal variation in the length of days, temperature, rainfall, or barometric pressure. Certain plants, however, exhibit a seasonal periodicity of growth or fruiting. The leaves of the native banyan (*Ficus marquisensis*) and the *vi* (*Spondias dulcis*) turn yellow and fall, and the native sugar cane blooms during the winter months of July and August. The breadfruit, according to native informants, yields the main crop at annual intervals.

FLORA

NATIVE AGRICULTURE

Both field and laboratory studies indicate that the number of plants of aboriginal introduction at time of discovery was much greater than the total number of indigeous seed plants. This is shown by the fact that while there are only 45 indigenous species and varieties of monocotyledons, there are 191 varieties derived through cultivation by the ancient Marquesans of monocotyledons introduced by them. The plants chiefly cultivated are banana (75 varieties), coconut (51 varieties), taro (30 varieties), and sugar cane (14 varieties); those less differentiated by cultivation are the pineapple (7 varieties), turmeric (7 varieties), ti (6 varieties), bamboo (4 varieties), and *Alocasia* or *kape* (3 varieties).

As the indigenous vegetation offered little in the way of food, it was necessary for the Marquesan not only to bring with him native food plants but also to develop a system of agriculture best adapted to the climate and soil conditions of the islands, and to the growing needs of the population. That he did this successfully is clearly shown by the following facts: (1) the large populations supported on comparatively small areas, Taipi, for example, a valley about 5 miles in length and 100 to 1200 feet in width supporting, according to reliable native informants, as many as 10,000 people; (2) the large number of varieties of food plants developed, such as breadfruit and taro; (3) the relics of intensive agriculture now existing in valleys formerly inhabited and in a very few isolated food valleys, for example, the one in the interior of the western part of Fatuhiva.

To accomplish this end it was necessary not only to study the plants cultivated and the topography of the islands but to work out, in an orderly manner, plantations which would afford the necessary food, both for the present population, and for expansions to meet the growing needs of the tribes. Therefore, every available space in the valleys and even on the mountain sides was utilized for the growing of food, medicinal, clothing, fiber, and ceremonial plants. In order to do this it was necessary to destroy the original vegetation, to select carefully new strains of food plants, and to grow them under conditions best suited to them in plantations having a definite order in the area occupied by the tribe.

Aside from these plantations, valleys which were extremely difficult of entrance were set aside and food plants planted in them and carefully cultivated for use in an emergency, such as a siege or famine. One such small valley was located at Hakau, Nukuhiva. Lately the cultivation of this valley has been neglected. In the interior of northwestern Fatuhiva, a similar

valley, several miles in extent, was visited, in which native agriculture was carried on, to all appearances, as in ancient times. So difficult was it to enter that not a single pig, goat, or other destructive animal had ever found its way there. As only natives entered, it had therefore remained quite undisturbed. The many phases of Marquesan agriculture which have been more or less completely effaced elsewhere in the islands existed here intact and could be traced out in detail. A more perfect plan of utilizing the cultural possibilities of the Marquesan climate, soil, and topography could hardly be devised.

SPECIES AND VARIETIES

The total number of species and varieties of monocotyledons found in the Marquesas, Rapa, Austral Islands, and the Tuamotus is 328. (See index.) Excluding 191 varieties which have evidently originated in the region through native cultivation, there remain 137 indigenous and introduced species and varieties.

The flora of the Marquesas comprises a total of 289 monocotyledons, of which 191 are varieties apparently derived by the Marquesans through cultivation of agricultural plants introduced by them. Of the 45 species and varieties that may be conservatively regarded as indigenous, 39 (84 per cent) are endemic. The indigenous monocotyledons are allied mainly to those of the Society Islands, Hawaii, and America; 33 per cent of the species and varieties having close allies in the Society Islands, 29 per cent in Hawaii, and 26 per cent in America. A slight affinity is indicated with Antarctica, New Zealand, Rapa, and Fiji.

Of the 18 indigenous monocotyledons of Rapa and the Austral Islands, 15 (83 per cent) are endemic, 22 per cent have close relatives in the Society Islands, 22 per cent have close allies in the Marquesas, 11 per cent are Antarctic in affinities, and 11 per cent are Malaysian.

The monocotyledons of the Tuamotus are of interest from their remarkably local distribution; 14 (87 per cent) of the indigenous species and varieties are endemic. Close affinities are shown with the coral islands of Polynesia and Malaysia.

MONOCOTYLEDONEAE

CHARACTERS AND FAMILIES REPRESENTED

Herbs, shrubs, or trees; stem with or without secondary thickening; vascular bundles irregularly arranged in cross-section, closed, without secondary thickening; veins parallel as a rule; flowers 3-merous.

Represented in the Marquesas by indigenous species of Gramineae, Cyperaceae, Orchidaceae, Pandanaceae, Palmae, and Liliaceae in order of relative abundance. The Gramineae (grasses) predominate in the coastal vegetation and on the arid prairie (*fenua ataha*) of western Nukuhiva. The Cyperaceae (sedges) occur in open situations from sea level to high altitudes. The Pandanaceae are represented by indigenous species of *Pandanus* and *Freycinetia*. The *Pandanus* (*ha'a* or *fa'a*) is found in the Marquesas from the shore line to 250 + meters elevation and commonly on gentle slopes of ravines. *Freycinetia* (*kiekic*) is characteristic of moist interior ridges and slopes at altitudes of 250 to 1000+ meters. *Pelagodoxa* is of special interest among the Marquesan palms.

KEY

- | | |
|---|---|
| 1. Shrubs or trees; inflorescence a spadix (2) | |
| 1. Herbs, rarely shrubs or trees; inflorescence various (3) | |
| 2. Fruits aggregate..... | 1. Pandanaceae , p. 27. |
| 2. Fruits not aggregate..... | 4. Palmae , p. 117. |
| 3. Perianth present (4) | |
| 3. Perianth absent (5) | |
| 4. Fruits forming a syncarpium..... | 6. Bromeliaceae (Ananas) , p. 137. |
| 4. Fruits not forming a syncarpium (7) | |
| 5. Inflorescence a spadix..... | 5. Araceae , p. 128. |
| 5. Inflorescence not a spadix (6) | |
| 6. Culms commonly terete..... | 2. Gramineae , p. 47. |
| 6. Culms commonly triangular..... | 3. Cyperaceae , p. 92. |
| 7. Ovulary superior (8) | |
| 7. Ovulary inferior (9) | |
| 8. Perianth symmetrical..... | 8. Liliaceae , p. 140. |
| 8. Perianth asymmetrical..... | 7. Commelinaceae , p. 139. |
| 9. Leaves commonly lobed..... | 10. Taccaceae , p. 154. |
| 9. Leaves entire (10) | |
| 10. Fruits fleshy, commonly seedless..... | 12. Musaceae , p. 158. |
| 10. Fruits dry (11) | |
| 11. Flowers symmetrical (14) | |
| 11. Flowers asymmetrical (12) | |
| 12. Inflorescence conelike..... | 13. Zingiberaceae , p. 161. |
| 12. Inflorescence not conelike (13) | |
| 13. Stamens united with style..... | 15. Orchidaceae , p. 170. |
| 13. Stamens free from style..... | 16. Cannaceae , p. 169. |
| 14. Twining plants..... | 11. Dioscoreaceae , p. 155. |
| 14. Not twining plants..... | 9. Amaryllidaceae , p. 155. |

FAMILY 1. PANDANACEAE

Trees, shrubs, vines, or lianes; leaves spirally arranged; aerial roots present or absent; flowers monosporangiate, arranged in heads or spikes; perianth absent or vestigial; stamens numerous; ovulary 1-10 + locular; fruits fleshy, fibrous or sclerous in texture, aggregate in heads or spikes (syncarpia).

Over 200 species distributed from tropical Africa and Asia through Polynesia. Although the family is now confined to the Old World, Berry (2, p. 76) has shown that near allies were of wider distribution in the Tertiary and were present in the region of Central America during the period when migration of angiosperms into Polynesia presumably occurred.

KEY

1. Locules containing several ovules; fruit a berry.....1. **Freycinetia**
2. Locules containing a single ovule; fruit a modified drupe or phalanx.....2. **Pandanus**

FREYCINETIA Gaudichaud

Shrubby vines or lianes climbing by means of aerial roots; leaves spirally arranged, linear to lanceolate; flowers without perianth, crowded in terminal or axillary spadices, monosporangiate, dioecious.

The native name, which is *kiekie* in both the Marquesas and New Zealand, is, with slight variations according to the local dialect, the name universally given to it throughout Polynesia; 'ie 'ie in Tahiti and Hawaii; *natal* and *poke* in Ponape, Caroline Islands. Over 60 species, nearly all insular, occurring in the high islands of the Pacific and the eastern part of the Indian Ocean, with the apparent present center (30 species) in the Malaysian region. The species are distributed in order of abundance as follows: New Guinea, 8 species; Celebes, Philippines, 7 species each; Java, 6 species; Fiji, 5 species; Borneo, New Caledonia, 4 species each; Sumatra, 3 species; Australia, Amboinia, Ceylon, Malay Peninsula, Marquesas, New Zealand, Solomon Islands, Samoa, 2 species each; Andaman, Austral Islands, Burma, Formosa, Hawaii, Norfolk, Tahiti, New Hanover, Timor, Tonga, 1 species each.

The distribution differs from that of *Pandanus* as follows: (1) It is practically absent from the continent and (2) from the Tuamotus and other low coral islands; (3) it extends into regions of lower temperatures, as far as Formosa on the north and New Zealand on the south, and it also occurs in the relatively cool, high altitudes of the Pacific islands.

KEY

1. Scandent; spadices 15 cm. long (2)
 1. Prostrate or somewhat scandent; spadices
 6 ± cm. long.....2. *Freycinetia monticola*
 2. Stigmas 4±.....3. *Freycinetia rapensis*
 2. Stigmas 6±.....*Freycinetia victoriperrea* (Brown, 7)
 2. Stigmas 10±.....1. *Freycinetia marquisensis*

1. *Freycinetia marquisensis*, new species (fig. 5a).³

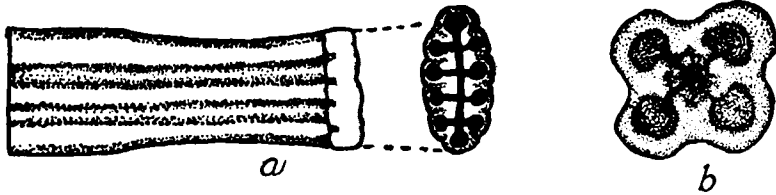


FIGURE 5a.—Drupes of *Freycinetia marquisensis*: a, side and end view of apical portion of mature drupe; b, *F. rapensis*, apical view of mature drupe enlarged.

Stems 3-4+ cm. in diameter, with few aerial roots, loosely climbing among trees to a height of 16+ meters; leaves crowded at the end of the branches, 80± cm. long, 5± cm. wide at the clasping base, tapering from the middle to a long, attenuate apex, the margin spinulose-serrate, the midrib serrulate toward the apex; inflorescence terminal, surrounded by a rosette of orange-yellow bracts, the inner series of which is fleshy and edible; spadices cylindrical, commonly ternate, up to 15 by 4.5 cm. when mature; peduncles 6± cm. long, branching from a common base, the angles minutely spinulose or smooth; fruits 18 by 3 mm., 5-10-carpellate, the dark stigmas 10±, arranged in an ellipse at the truncate apex of the fruit.

Marquesas, Nukuhiva, Tovii, July 1, 1921, F. Brown, no. 459, type. Marquesas, Hivaoa, Ootua, December, 1921, F. Brown, no. 1062; Nukuhiva, September, 1922, E. H. Quayle, nos. 1286, 1273, reference types.

The species seems intermediate between *F. arborea* of Hawaii and *F. victoriperrea* of Tahiti. Its stronger stems, fewer aerial roots, and less dependent habit of growth distinguish it from the Hawaiian *F. arborea*; while it differs from the Tahitian *F. victoriperrea* by its broader leaves, cylindrical spadices, and more numerous ovulary carpels.

The fleshy floral bracts were eaten raw, particularly in time of famine; the interior bast strands of the aerial roots furnished a flexible fiber highly esteemed for braided cordage. A desirable element of the indigenous forest, where it serves the purpose of smothering out invading weeds and protecting the seedling reproduction of native trees.

The native name is *kiekie* in the Marquesas. Endemic; frequent, 200 to 600 meters elevation, in the rain forest of all the Marquesan islands.

³All plants described in this paper are in the herbarium of Bernice P. Bishop Museum.

2. *Freycinetia monticola*, new species (Pl. XIX).

Shrubby, prostrate, or somewhat scandent, 2-3+ meters in height; stems woody, $2.5 \pm$ cm. in diameter, with few or no aerial roots; leaves crowded near the ends of the branches, linear-lanceolate, tapering gradually into a slender tip, 2.5-7.5 cm. long, 1-3 cm. broad at the base, the apical portion minutely spinulose-serrate along the margin and midrib; floral bracts forming a rosette at the base of the terminal inflorescence, $10 \pm$ in number, lanceolate, the inner ones slightly longer than the spadix, the outer ones $20 \pm$ cm. by $2 \pm$ cm. long, bright reddish-orange in color; peduncles subglabrous, unbranched, $3 \pm$ cm. long; spadices single from the axils of the uppermost floral bracts, clustered $4 \pm$ in number in the center of the colored rosette, cylindrical, 6-9 cm. long, $1 \pm$ cm. in diameter at time of flowering; staminate spadices deep-salmon in color, the ovularies vestigial, the anthers 0.8 mm. long, the filaments $15 \pm$ mm. long; carpellate spadices green, the ovularies composed of $6 \pm$ carpels, the stigmas sessile, arranged in an ellipse.

Marquesas, Hivaoa, Feani, December 21, 1921, F. Brown, no. 870, type. Marquesas, Uapou, September, 1922, E. H. Quayle, no. 1135, reference type.

The native name is *kiekie*. Endemic in the Marquesas and common throughout the archipelago at high altitudes (1000+ meters), in more or less open, precipitous exposures of the cloud zone, where it forms a desirable ground cover. The somewhat fleshy floral bracts, which were available to a limited extent, were used as raw food in time of famine. The few aerial roots furnish a flexible fiber for braided cordage.

3. *Freycinetia rapensis*, new species (fig. 5a).

Carpellate syncarpia terminal, pedunculate, $4 \pm$ in number, $15 \pm$ cm. in length, $23 \pm$ mm. in diameter; peduncles $43 \pm$ mm. long, $8 \pm$ mm. in diameter, glabrous; staminodea minute, scalelike, persistent at the base of the fruit; fruits red in color, fleshy, $10 \pm$ mm. in length (dry), including the sclerous apex $3 \pm$ mm. long, seed-bearing in the lower 8 mm.; stigmas $4 \pm$, surrounded by an outer sclerous 4-5-sided ring 3 mm. in diameter.

Rapa, February 24, 1922, E. H. Quayle, type (only syncarpia collected).

Although a more generalized type with a large number of ovulary carpels, it appears to be related to *F. australiensis* of Australia. A specimen collected June 10, 1921, by A. M. Stokes, no. 44, at Maitua, Rapa, consisting of a single leaf and aerial root, probably belongs to this species. This leaf is 90 cm. in length and 33 mm. broad, tapering gradually to the apex, minutely spinulose-serrate on the margin and under surface of the midrib, the spines more or less reduced in the lower portion of the leaf.

The native name is *mangu*; aerial roots known as *kiekie*. The fruits are used as raw food, and baskets are made from the roots. Endemic in Rapa.

2. PANDANUS Linnaeus

Trees or shrubs; flowers dioecious, without perianth, arranged in spadices; staminate spadices thyrsoid; carpellate spadices simple with few exceptions; syncarpium spherical, ellipsoidal, obovoidal, or cylindrical; locules uniovulate.

1-10 + in number; fruit a drupe or phalanx; exocarp thin, sclerous; endocarp hard, stony; mesocarp fibrous, pithy, or fleshy; seeds small ovoidal, ellipsoidal, or fusiform; testa membranous; endosperm abundant, rich in oil and aleurone.

A genus of approximately 140 species, similar to *Freycinetia* in distribution, but extending eastward to Africa. It is slightly more confined to tropical climates than *Freycinetia*, being absent from New Zealand on the south, and from Formosa on the north. In Polynesia, *Pandanus* drops out in the high and comparatively cool altitudes in which *Freycinetia* is common, and thrives on low coral atolls where *Freycinetia* is absent.

SECTION KEURA (FORSKAL) S. KRUZ

Drupe composed of several locules concentrically or irregularly arranged; stigma oblique or erect; stamens arranged on a columnar axis, subfasciculate or racemose. The following described all belong to this section. (See Pl. XX.)

STRUCTURE AND COMPOSITION OF FRUITS

The fruits, which are botanically of special interest, were highly esteemed by almost every branch of the Polynesian race for food, fermented drink, decoration, both festive and religious, or for the fragrant essential oil of some species, used in scenting coconut oil.

The fruits are remarkably specialized drupes or phalanges, furnishing many highly important characters necessary in the classification of the species and varieties belonging to this rather difficult genus. The dome-shaped apical portion of the fruit (fig. 6), extending from the endocarp upwards, is light, serving to float the drupe indefinitely in water. The outside covering is a waterproof layer (exocarp) of cuticle and epidermis, united at the lower part with an impermeable floor formed by the endocarp which cuts off the penetration of water from below. The interior of this portion of the fruit (the apical mesocarp) is made up of light, buoyant, floating tissues. It is composed of (1) large air cavities, (2) aerenchyma or floating tissue, and (3) a supporting framework of strong, light strands of fibers. In several of the relatively primitive species (*P. tectorius*, fig. 8; *P. schizocarpus* and *P. katensis*, fig. 11), the apical mesocarp is divided into domelike subdivisions or locules, one to each carpel. In other less primitive forms, the apical locules are fused, resulting in the locular chambers merging more or less completely into one (*P. tuamotensis*, fig. 10).

A comparative study of the fruits of coral and high island species shows that, in general, the floating tissues seem better developed in the coral or low island types. Fresh fruits being heavier, when placed in water tend to float in an upright position with approximately one-fifth of the surface emerged (fig. 6); dry, lighter ones float on the side.

The endocarp differs greatly with the species. It may occur exactly at the center of the drupe or above or below it, and may be spherical or variously compressed. In most Polynesian species the endocarp is extremely hard and bony, thick-walled, dark brown and subimpermeable to water. This is due to the infiltration of a dark-brown, resin-like substance filling the lumina of the thick-walled fibers of which it is composed. The seed-bearing locules are small, isomerous with the carpels, each containing a single small ellipsoidal seed, rarely as long as twice the length of a grain of wheat.

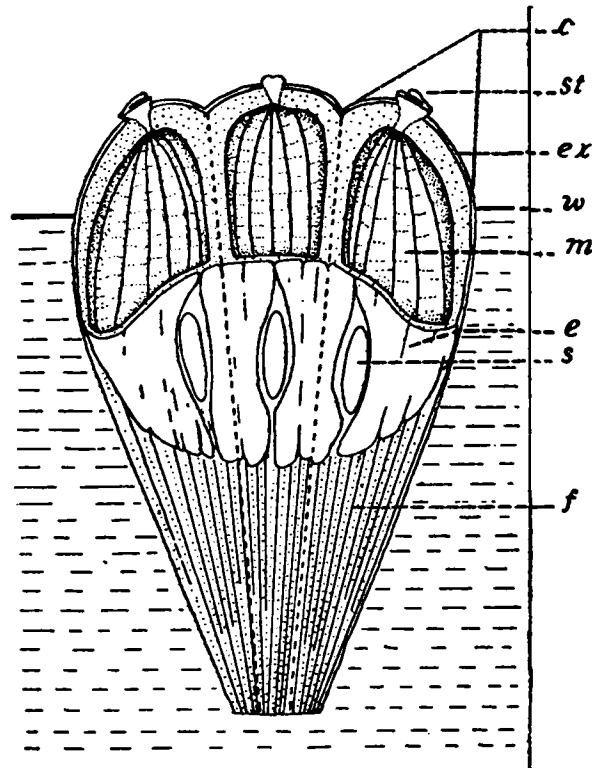


FIGURE 6.—Drupe of *Pandanus* in longitudinal section, buoyancy of the green fruit in water: *c*, carpel; *ex*, waterproof cuticle and epidermis (exocarp); *e*, endocarp; *f*, edible flesh (basal mesocarp); *m*, floating tissue (apical mesocarp); *s*, seed; *st*, stigma; *w*, waterline.

The basal mesocarp is well developed and edible in all species collected, with the single exception of *P. rapensis* (fig. 9, *c*). Structurally, this portion of the drupe or phalanx is composed of rather thin-walled, finely pitted storage parenchyma, traversed lengthwise by numerous strands of bast 0.1-0.7 mm. in diameter. This renders the flesh more or less stringy in texture. In types poor in carbohydrates the fibrous strands tend to be coarse, and in

those rich in carbohydrates the fibrous strands tend to be fine. The sides of the basal portion are covered with a thin epidermis which is persistent in some of the high-island types (*P. tectorius*) and deciduous in low or coral island types (*P. tuamotensis*). In general, persistent epidermis is associated with low carbohydrate content, and deciduous epidermis is associated with high carbohydrate content.

The chief food constituents of the drupe are, as a rule, located in the basal portion of the mesocarp. They are perishable carbohydrates, consisting chiefly of dextrose (grape sugar) and starch. The seeds present in the endocarp, although edible, rich in oil and aleurone, and having the flavor of a pecan, play practically no part in the diet except in times of famine. Doubtless this is due to their small size and the difficulty of extracting them from stonelike endocarp. Living protoplasm is also present in the cells of the basal mesocarp, together with a finely granular substance (protein?) which stains yellow with iodine. The presence of pectin is indicated by the violet reaction to methylene blue and by the fact that a concentrated extract obtained by boiling the crushed basal mesocarp in a small amount of water tends slightly to coagulate and form jelly when cooked. This, together with the finely divided particles of the cooked flesh, forms a substance not unlike jam, yellow in color, rich in grape sugar and, in flavor, similar to the taste of jam made from ripe ground cherry (*Physalis peruviana*).

A quantitative determination of the sugar content of the *Pandanus* fruit (basal mesocarp) kindly made by R. H. King of the Hawaiian Sugar Planters' Association, led to the surprising discovery that 25 per cent of the dry weight of this tissue in one of the coral island species (*P. pulposus*) is composed chiefly of dextrose (grape sugar). His analysis shows that the dry weight content of sugar (chiefly dextrose) of *Pandanus* flesh is equal to nearly half the sugar content of sugar cane (50 per cent sucrose, 2 per cent dextrose) but entirely different chemically, being chiefly dextrose in *Pandanus* and chiefly sucrose in *Saccharum* (sugar cane). On analysis of living weights he found 3.75 per cent sugar (dextrose) in *Pandanus* as compared with 13 per cent of sugar (sucrose and dextrose) in sugar cane.

The starch content of the fruit varies greatly in amount, being absent in some storage parenchyma cells and abundant in others cut from the same piece of tissue. Doubtless the relative proportion of starch and dextrose changes as the fruit ripens.

The food elements contained in the flesh of *Pandanus* fruits rich in carbohydrates soon spoil after the ripening of the drupes, allowing the epidermal covering to drop off, thus leaving the basal fibers free like the bristles of a brush (*P. tuamotensis*, fig. 10).

With rare exceptions, the different species of *Pandanus* are known by the same general (generic) term, or minor variations according to dialect, in

nearly every part of Polynesia, as follows: *ha'a* in northern Marquesas, *fa'a* in southern Marquesas, *hala* in Hawaii, *fara* in the Society Islands and in Nuku-oro of the Caroline Islands, *hara* in Aitutaki, Cook Islands, *fala* in Funafuti, Ellice Islands, *fa*, *fala*, *fara*, *'ara*, *hara* in Niue and Samoa, *timo* in Katiu, Tuamotu Islands, *ka'ara* in Rapa.

The Marquesans distinguish a number of varieties or species, based chiefly on fruit characters, as follows: (1) *ha'a kua*, fruits red in color (*P. tectorius* var.), sacred; (2) *ha'a mei*, fruits yellow (*P. mei*); (3) *ha'a taepa*, fruits transversely banded with red and yellow (*P. tectorius* var. *taepa*); (4) *ha'a ma'oi*, fruits light-pink (*P. tectorius* var.). According to Henry (20, p. 55), the 11 Tahitian varieties can be grouped into lowland varieties, mountain varieties, and seashore varieties.

There is no doubt that *Pandanus* is by far the most important and useful genus of monocotyledons to the Polynesian inhabitants of tropical Pacific islands. In fact, in the low tropical coral island of the Pacific, it may well be considered the most important of all genera, either of the monocotyledons or dicotyledons. Throughout the Tuamotu Islands, aside from its many other forms of usefulness, it was the chief source of plant food of the ancient inhabitants. According to Hedley (18, pp. 29-31), it was also the most important genus of food plants in the Ellice Islands, Gilbert Islands, and the equatorial islands; also it was an important genus in the diet of the inhabitants of northern Australia. On the low coral islands, under conditions where taro, banana, sweet potato, breadfruit, and every other native food plant, with the exception of coconut, cannot be grown without the greatest difficulty, uncertainty, or failure, it flourishes without cultivation and is a never-failing source of food. On the high tropical islands, such as the Marquesas, while not important as a food plant except in times of famine, on account of the possibility of the cultivation of such native food plants as breadfruit and taro, it was used for many purposes, such as adornment, the scenting of coconut oil, intoxicating drinks, mats, sails, thatch for houses, fiber for cordage, and wood for spears. One variety became so closely associated with religious practices as to be considered sacred. (See p. 39.)

If the ripe fruits are needed for immediate consumption, they are either boiled in water, roasted on the fire, or baked in the native oven. If the fruit is to be preserved for future use it is pounded to a meal and dried in the sun, either pure or mixed with freshly grated coconut meat. When thoroughly dried, it forms a hard cake which may be preserved indefinitely to be cooked as food when desired. Hedley (18) describes other foods prepared from the drupes of *Pandanus*.

Although the taste of the raw fruit of *Pandanus* is not disagreeable, the irritation to the mouth and throat, doubtless caused by the presence of needle-

shaped crystals of calcium oxalate (fig. 7, *e*), makes its use as a raw food even in times of famine more or less annoying or even impossible. This irritating effect, while somewhat like that produced by raw taro, is far less painful and is more pronounced in some species and varieties than in others. As with taro, cooking destroys the irritating agencies.

Another objectionable feature of the *Pandanus* fruit for food is the presence of the numerous fibers. Although these are not removed by cooking, they may be separated without difficulty from the edible portion of the

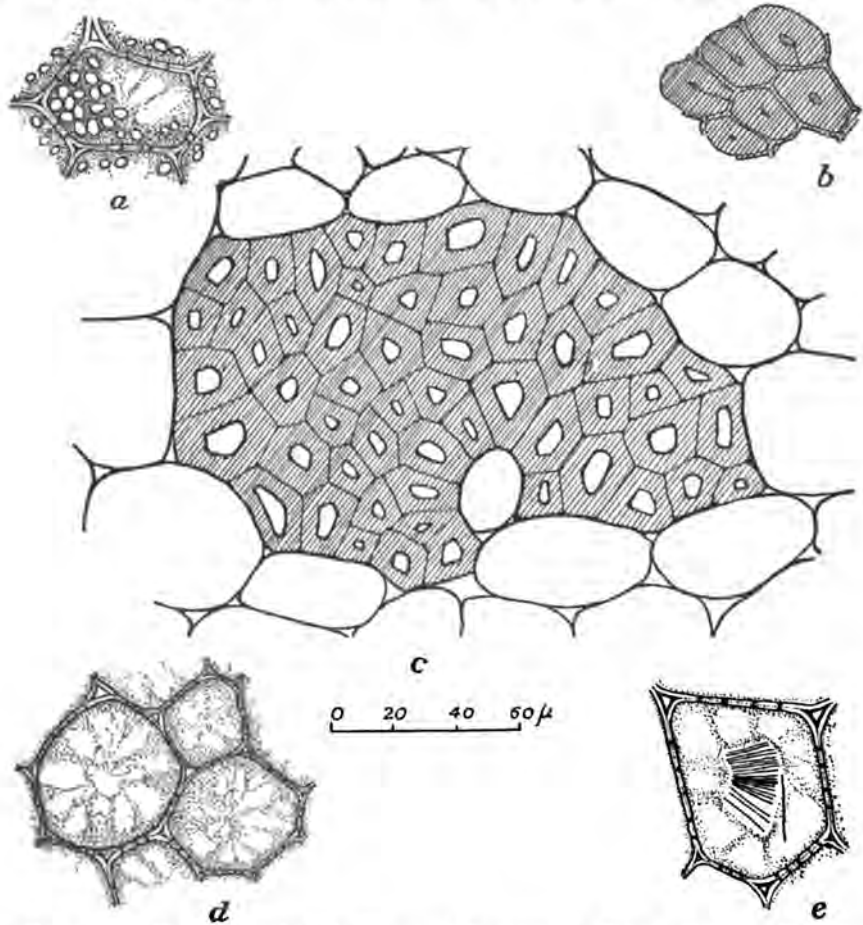


FIGURE 7.—Micro-anatomical characters of *Pandanus*: *a*, living cell from edible basal mesocarp of drupe containing dextrose in solution, and granules of starch; *b*, section of bonelike endocarp showing extremely thick-walled fibers with small lumina plugged with dark-brown resin-like material; *c*, cross section of bast strand (highly valued for cordage) from the aerial root of *P. tectorius*; *d*, living cells from edible basal mesocarp from drupe of coral island type (*P. tectorius*) containing dextrose; *e*, living cell from edible mesocarp of drupe of *P. tectorius* containing needlelike crystals of calcium oxalate.

cooked fruit. In the raw state the edible portion is chewed until the soft food-containing tissues are removed. The remainder of the drupe, with the fibers attached at the end like the bristles of a brush, is then thrown away.

Both in the Marquesas and the Tuamotus, an intoxicating drink was made by fermenting the sugar content of the basal mesocarp of the fruit, which is similar to that of birch sap. However, the drupes of all the Marquesan species furnish only a limited quantity of substance available for food or drink. The seeds are few, small, and well flavored, but the fleshy tissues are poorly developed and contain a large portion of coarse fibers.

For the purpose of adornment, *hei* (leis, wreaths, garlands) were made either of the entire highly colored fruit or only of the basal portion. If whole fruits were used, they were tied singly or in groups of five by means of a narrow ligule stripped from the outer tissues of the drupe, to a fiber. This fiber was obtained either from the midrib of the ti leaf (*Cordyline terminalis*) or from the bast of the hau (*Hibiscus tiliaceus*). If only the basal portion of the fruit was used, these portions were pierced longitudinally and strung on a fibrous cord, like beads.

The *Pandanus lei* (*hei ha'a*) was worn chiefly by men. Ordinarily only a short lei was placed on the head as a crown, or around the neck. On festive occasions, in addition to these, long ones were draped on the shoulders and about the body.

Leis were also made from the yellowish-white bracts of the staminate inflorescence (*hinano*), which has a very strong pungent odor. Either they were made into a special kind of lei or interspersed among flowers in various kinds of flower leis.

To scent coconut oil used for anointment, the bracts were highly esteemed, but pieces of the fragrant tissue of the ripe drupe were also used for the same purpose.

In early pre-European times, thatch made of *Pandanus* was used by the Marquesans almost exclusively for the native houses. The use of coconut for the making of thatch became a general practice only after the establishment of the copra industry by the French. When coconut thatch is used, the trough-shaped *Pandanus* leaves are considered superior to all others in making a water-tight ridge for the roof.

For weaving purposes the leaves are first stripped of the spines which occur along the margin and under surface of the midrib. This is done by drawing the leaf between coconut fiber held on the thumb and first finger. They are then split lengthwise into long ribbons, which are woven single-ply into house mats or three-ply into sails for canoes.

The tip of the aerial roots is tender and, according to Henry (4), the mature aerial roots furnish an abundance of slender, flexible, rather strong fibrous strands, $0.2 \pm$ mm. in diameter, used chiefly in making twisted or

braided cordage; in Aitutaki, Cook Islands, they were used for binding thatch (Buck, 9, p. 12). These strands are composed entirely of bast fibers with open lumina and moderately thickened walls. The somewhat coarser, ($0.5 \pm \mu$ in diameter) fibrous strands from the husk of the coconut are used for somewhat similar purposes, but are not as strong in proportion to diameter due partly to the presence of a core of soft tissue extending from the side to the center and visible in the cross section with a lens. The fibers also are relatively weak, as the walls are only $4 \pm \mu$ in thickness. As a result, coconut fiber strands are brittle and tend to break off with a conchoidal fracture; strands obtained from the root of *Pandanus* are tough, tending to splinter or fray at the broken ends. The outer zone of the wood in *Pandanus* is hard, strong, and highly valued for making spears.

In all likelihood, the useful species of this genus were cultivated by the Polynesian races from the very beginning of their agricultural practices. If so, it may be assumed that many characters of the species and varieties here described, such as the coloration, size, and food content of the drupes, the spineless margin and fine texture of the leaves, and the flowerless habit of growth are the result, in part, of selective cultivation practiced by the ancient Polynesians. It may be found that certain species, such as *P. bergmanii* from Washington Island, have been developed partly through cultivation and are of ancient aboriginal introduction rather than indigenous to the island on which they are now found.

The Marquesan species seem well adapted for planting in forestry or landscape gardening, under conditions where the sharp spines of the leaves and trunk are not objectionable. Mats, hats, fans, and similar things woven from the leaves by the natives of the Marquesas and other island groups of Polynesia are valuable in the tourist trade. Articles made from the long spineless leaves of the Tahitian *paore* (*P. tectorius* var. *laevis*) are considered superior in quality and command a higher price than those woven from leaves of the indigenous spiny species. Certain species are reliable food plants for cultivation on the remote coral islands.

Notwithstanding the buoyancy of the green and dry fruits, there appears at present to be little if any interisland dispersal of the species and varieties which seem very local in distribution. *P. tectorius* is the single species with a wide distribution in the Pacific area, but the varieties are clearly defined and apparently endemic. In all probability certain species and varieties cultivated by the Polynesians are of ancient aboriginal introduction rather than indigenous to the islands where they now occur. That the drupes are not more widely distributed by ocean currents may be because the seeds are open to the attack of small marine organisms, which could probably penetrate the channels of soft tissue leading from the base of the endocarp to the seed cav-

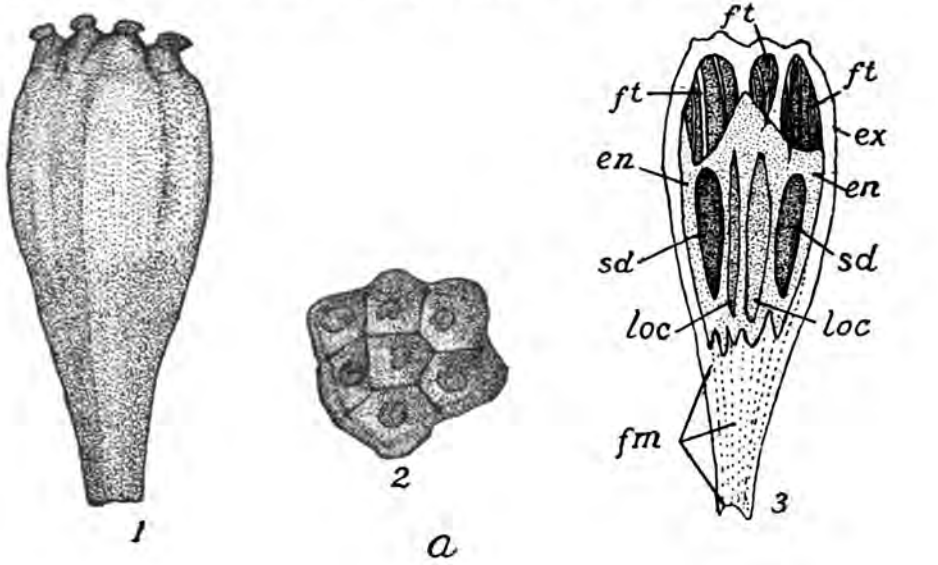
ities. Introduced rodents are able to gnaw through the endocarp of the Marquesan species.

KEY

1. Leaves unarmed.....1b. *Pandanus tectorius* var. *laevis*
1. Leaves armed (2)
2. Drupes without basal mesocarp.....6. *Pandanus rapensis*
2. Drupes with basal mesocarp (3)
3. Endocarp subspherical, locular sutures shallow; high-island types (4)
3. Endocarp more or less compressed, locular sutures deeply indented at the sides; coral-island types (7)
4. Drupes, long, narrow, commonly less than 3 cm. broad.....2. *Pandanus mei*
4. Drupes commonly over 3 cm. broad.....(5) *Pandanus tectorius* varieties
5. Apical mesocarp chambers longer than broad.....1d. *Pandanus tectorius* var. *jonesii*
5. Apical mesocarp chambers not elongated (6)
6. Lateral sutures prominent.....1a. *Pandanus tectorius* var. *taepa*
6. Lateral sutures superficial.....1c. *Pandanus tectorius* var. *uspensis*
7. Drupes $12 \pm$ cm. long.....*Pandanus bergmanii* (Brown, 7)
7. Drupes under 12 cm. long (8)
8. Drupes nearly twice as long as broad...*Pandanus pulposus* var. *cooperi* (Brown, 7)
8. Drupes nearly as broad as long (9)
9. Apical sutures deep.....5. *Pandanus schizocarpus*
9. Apical sutures not deep (10)
10. Apical mesocarp not distinctly divided into carpellate chambers.....4a. *Pandanus tuamotensis* var. *typica*
10. Apical mesocarp subdivided into carpellate chambers (11)
11. Endocarp moderately compressed, $2 \pm$ cm. thick.....4. *Pandanus tuamotensis* var. *locularis*
11. Endocarp greatly compressed, less than 2 cm. thick.....3. *Pandanus katensis*

1a. *Pandanus tectorius* Solander var. *taepa*, new variety (Pl. XXXI, B; fig. 8).

Tree $7 \pm$ meters in height, with a trunk $10 \pm$ cm. in diameter, supported at the base with heavy brace roots, sparingly branched above, forming an open crown $4 \pm$ meters in diameter; stem $10 \pm$ cm. in diameter; the surface armed with short, stout prickles and more or less covered with light-gray lichens; leaves spirally arranged at the ends of the branches, linear, gradually acuminate, 5 by $150 \pm$ cm., deeply channeled, sharply spinose-serrate along the margins and on the under surface of the midrib; bracts of staminate inflorescence linear-lanceolate, $20 \pm$ cm. long, white, with a strong pungent odor; synocarpium globose, pendent, $18 \pm$ cm. in diameter, composed of $85 \pm$ drupes; drupes angular pyramidal, the sutures obscure or prominent but not deep, somewhat compressed, $63 \pm$ mm. in length, $45 \pm$ mm. in extreme width, red on the sides in the apical third, yellow in the basal two-thirds, composed, as a rule, of five outer carpels surrounding a sixth central one; carpels convex at the apex, terminating in a low sclerous suborbicular-reniform persistent stigma; endocarp osseous, thick-walled, suborbicular in longitudinal section, slightly supramedian in position, nearly as broad as the drupe; upper mesocarp $15 \pm$ mm. in height, the lacunae (*m*) traversed by stiff fibers imbedded in thin-walled parenchyma; lower mesocarp (*f*) $18 \pm$ mm. in height, composed of very stiff fibers $0.6 \pm$ mm. in diameter, imbedded in thin-walled sacchariferous starchy parenchyma; seeds obovoid or ellipsoid, $23 \pm$ mm. in length.



0 1 2 3 4 5 cm

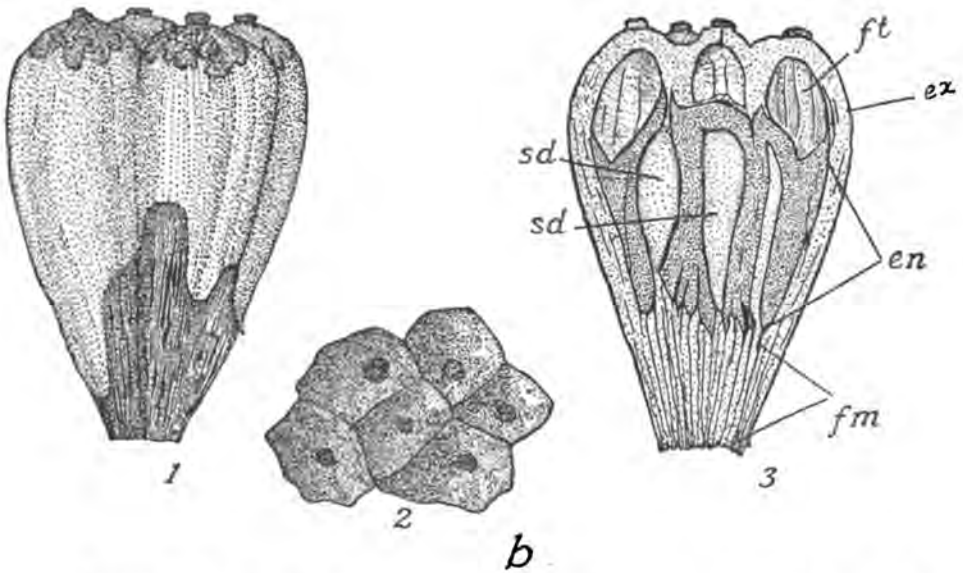


FIGURE 8.—Drupes of high island types of *Pandanus*: a, *P. mei*; b, *P. tectorius* var. *taepa*; 1, lateral view; 2, apical view; 3, longitudinal section; *en*, endocarp; *ex*, exocarp; *fm*, fleshy basal mesocarp; *ft*, floating tissue (apical mesocarp); *loc*, locule; *sd*, seed.

Marquesas, Nukuhiva, July 15, 1921, F. Brown, no. 512, type.

One form of this variety which occurs frequently in the Marquesas is considered sacred by the natives. This form differs from the type in the color of the fruits, which are deep-red, and may have originated through native methods of selection and cultivation.

The native names of the forms are as follows: *ha'a taepa*, a form with fruits transversely banded with red and yellow; *ha'a kua*, a form with deep-red fruits. The wood was highly valued for spears by the natives; fruits (drupes) of the typical variety (*ha'a taepa*) were used for leis and food. Fruits of the form *ha'a kua* were considered sacred, being strictly tapu except for use in religious ceremonies; they were used for making leis with which to adorn the *tikei* (*tikis*), never being worn by the people. The seeds, although small, are edible, having an agreeable pecan-like flavor. The mesocarp contains a limited quantity of starch and sugar, serving as an available food in times of famine; other uses of the fruit are the same as those cited for the genus.

1b. *Pandanus tectorius* Solander var. *laevis* (Kunth) Warburg.

"Leaves $2 \pm$ m. long, 5-6 cm. broad, long acuminate, margin and midrib smooth; carpellate inflorescence and fruit unknown."—Warburg (45, p. 48).

Marquesas, Hivaoa, Atuona, April 22, 1921, F. Brown, no. 348, reference type; not found in flower or fruit.

The leaves of this variety, on account of their finer quality, great length, and absence of spines, are considered superior and are preferred by the natives for fine weaving. The plant is easily propagated from sprouts which are freely formed at the lower leaf-axils. It is now cultivated in small amounts in nearly every inhabited valley of the Marquesas.

This variety is also found in Java. According to native informants, it was introduced into the Marquesas from Tahiti. It is known throughout the Marquesas by the Tahitian name *paore*.

1c. *Pandanus tectorius* Solander var. *uapensis*, new variety (fig. 9, a).

Tree 3-5 + meters high, 10-15 cm. in diameter breast high; drupes 5.4 cm. long, free and divergently curved in the upper third; apical and lateral locular sutures very shallow or superficial; apical mesocarp rather obscurely divided into carpellate chambers with thin or incomplete lateral walls, the interior chambers traversed by coarse fibrovascular strands separated by wide intrafascicular cavities containing little or no intrafascicular pith; endocarp semicircular above (longitudinal section), upwardly directed at the margin, semicircular below; stigmas apical, subcircular, very slightly protruding, sub-erect, cordately notched on the inner face, $3 \pm$ mm. in diameter; basal mesocarp rather succulent, traversed by moderately coarse fibrovascular strands $0.5 \pm$ mm. in diameter, the epidermis finally deciduous, leaving the fibers free.

Marquesas, Uapou, altitude 100 meters, September 9, 1922, W. B. Jones, no. 1134, type.

Though it closely approaches the Nukuhivan variety *taepa*, the variety *uapensis* is fairly distinct. It is distinguished by the length of the drupe, the superficial locular sutures, the low apical curve, the poorly defined apical chambers of the locules, and the relatively slender fibrovascular strands of the basal mesocarp.

The wood of this variety is valuable for spears; the roots for fiber; the leaves for thatch (in ancient times) and mat weaving; the drupes for leis, fermented drink, and famine food.

Endemic in Uapou.

1d. *Pandanus tectorius* Solander var. *jonesii*, new variety (fig. 9, b).

Tree 3-5+ meters high, 10-15 cm. in diameter breast high; drupes $6 \pm$ cm. in length, convex at the apex, free and divergently curved from each other in the upper third; apical sutures defined by shallow v-shaped indentations; lateral sutures superficial, rarely defined by narrow intrusions; locules $6 \pm$ in number, concentrically arranged, slightly convex and marked with corky scars and patches at the apex, the outer ones relatively large; stigmas apical and central in the inner locules, inwardly eccentric in the outer locules, suberect, slightly protruding, subcircular and commonly broader than long, $3 \pm$ mm. in width, cordately indented on the inner surface; endocarp placed slightly more in the base of the drupe than in the apical portion, osseous, thick walled, rimose, as broad as the drupe, subspherical in shape with an upwardly directed margin; apical mesocarp divided into distinct locular chambers, the outer ones $25 \pm$ mm. in length and twice as long as the central one, traversed by coarse fibrous strands separated by wide intrafascicular cavities and thin-walled parenchyma; basal mesocarp less in volume than the endocarp, with very coarse, stiff fiber strands $0.7 \pm$ mm. in diameter.

Marquesas, Eiao, altitude 200 meters, September 20, 1922, W. B. Jones, no. 1511, type.

This variety is fairly distinct, differing from variety *taepa* in (1) the position of the endocarp, (2) the length of the apical and basal mesocarp, (3) the diameter of the basal fibrous strands.

Endemic in Eiao, an uninhabited island (fig. 2), rare in valleys, very common on top of ridges and on windward slopes.

2. *Pandanus mei*, new species (Pls. XX, XXI; fig. 8, a).

Tree $10 \pm$ meters in height, branching above in an open crown; trunk $18 \pm$ cm. in diameter, with light gray surface armed with numerous short conical spines, supported at the base by heavy brace-roots; leaves linear, $2 \pm$ meters long, $10 \pm$ cm. broad at the base, tapering to a long acuminate apex, provided with sharp spines along margin and midrib; bracts of staminate flowers fragrant, pungent; syncarpium ellipsoidal, 25 cm. by 21 cm., $4 \pm$ kilos (9 pounds) in weight, composed of $195 \pm$ bright-yellow drupes; drupes narrowly obovate, 7 by $2.5 \pm$ cm., composed of $6 \pm$ carpels, which are convex at the apex; stigma prominent, apical, reniform, $2 \pm$ mm. high, $4 \pm$ mm. in diameter; exocarp $2 \pm$ mm. thick at the apex, covered throughout with a persistent epidermis; apical mesocarp divided into distinct locular chambers $14 \pm$ mm. in height, $7 \pm$ mm. broad, traversed by coarse fibers imbedded in thin-walled parenchyma (floating tissue);

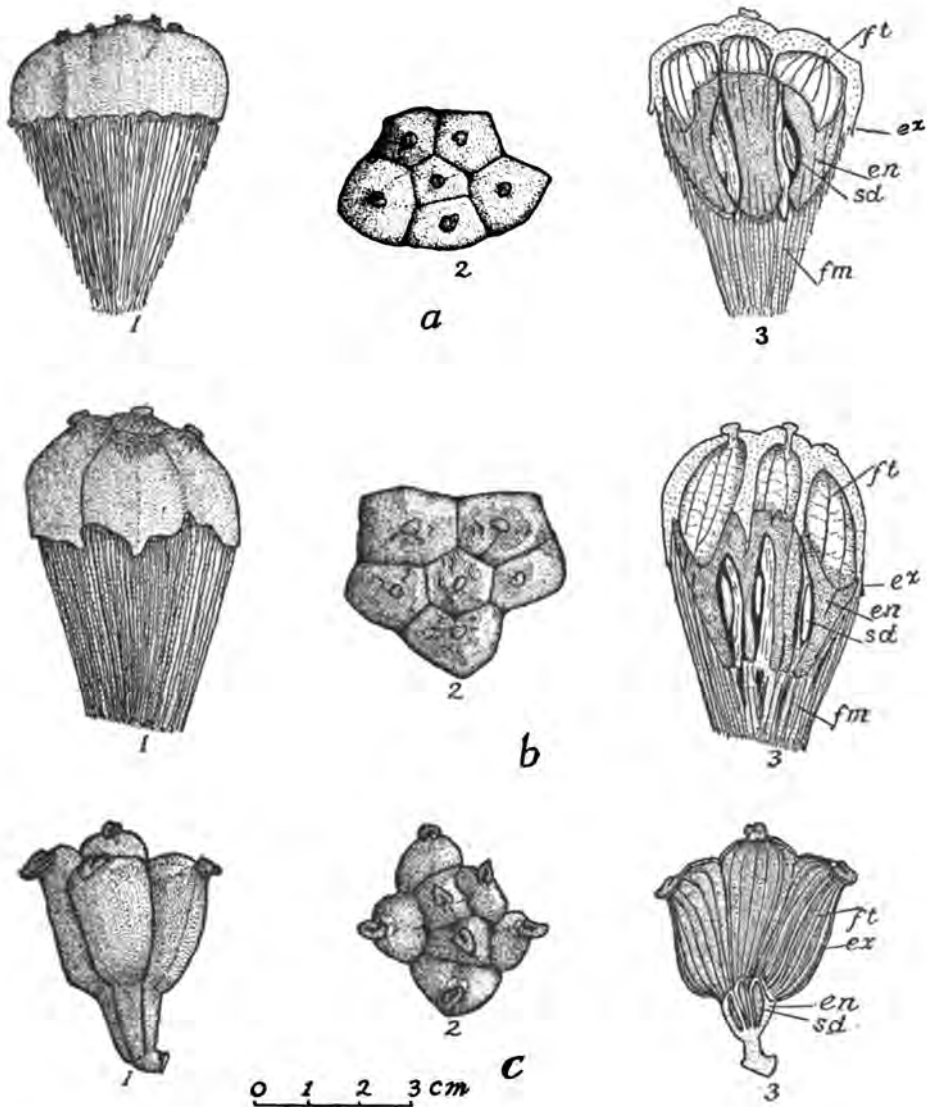


FIGURE 9.—Drupes of high island types of *Pandanus*: a, *P. tectorius* var. *uapensis*; b, *P. tectorius* var. *jonesii*; c, *P. rapensis*: 1, lateral view; en, endocarp; ex, exocarp; fm, fleshy basal mesocarp; ft, floating tissue (apical mesocarp); sd, seed; 2, apical view; 3, longitudinal section.

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basal mesocarp somewhat fleshy, $2 \pm$ cm. long, 5-13+ mm. wide, with numerous rather coarse fibrous strands $0.4 \pm$ mm. in diameter, imbedded in rather thin-walled storage parenchyma containing starch and sugar; endocarp situated partly in the apical portion of the drupe, subspherical, very hard, dark in color, nearly as broad as the drupe, $37 \pm$ mm. in height; seeds broadly spindle-shaped, $2 \pm$ cm. long, $5 \pm$ mm. wide.

Marquesas, Hivaoa, Puamau Valley, April 22, 1921, F. Brown, no. 365, type.

The drupes are used for leis; the seeds are edible; the basal mesocarp is fermented for drink and furnishes food in time of famine; the wood is valued for spears; the leaves were used for thatch in early pre-European times and are still woven into mats and sails. Its attractive growth form recommends this species for landscape planting. Some forms have pink or light-red drupes.

The native name in Hivaoa is *fa'a mei*, meaning "breadfruit *Pandanus*," probably given because of the size and shape of the syncarpium. Endemic in Hivaoa, where it is common in forests at an altitude of about 300 meters.

3. *Pandanus katensis*, new species (fig. 11, b).

Shrub $2 \pm$ meters in height; leaves $125 \pm$ cm. long, $5 \pm$ cm. wide, tapering gradually to the apex, sharply spinose-serrate along the margin; midvein depressed above, acute along the under surface, armed with sharp spines along the apical portion, unarmed near the base; serratures rather distant, small, rarely over 2 mm. in length; veins slender, numerous, $28 \pm$ in number per cm.; syncarpium of medium size, subglobose-ellipsoidal in shape, $16 \pm$ cm. in length, $15 \pm$ cm. in width, composed of $33 \pm$ drupes; drupes rather large, 10-14—locular, broadly cuneate in shape, free in the upper third, irregularly pentagonal in cross section, $5 \pm$ cm. long, $6 \pm$ cm. broad; sutures prominent, deep; carpels convex, scarred with corky lines and checks at the apex; stigma sessile, apical in position, irregularly orbicular-reniform in shape, $5 \pm$ mm. broad; endocarp osseous, thick-walled, as broad as the drupe, greatly compressed dorsiventrally, $17 \pm$ mm. in axial thickness, situated approximately two-thirds in the apical half of the drupe; upper surface convex; lower surface concave or nearly flat; apical mesocarp chambers broad, $14 \pm$ mm. in axial length, traversed by coarse fibrous strands with little or no parenchyma and large intrafascicular cavities; basal mesocarp abundant, $25 \pm$ mm. in length, composed of slender fibers $0.2 \pm$ mm. in diameter, imbedded in copious thin-walled parenchyma stored with starch and sugar; seeds small, slightly larger than a grain of wheat.

Tuamotu Islands, Katiu, April 4, 1921, F. Brown, no. 308, type.

Seems closely allied to *P. brachycarpus* (Martelli, 41, p. 431 and table 34, figs. 1-3) of Tubuai, from which it differs in the size of the syncarpium, the number of drupes and locules, the deep furrows separating the carpels, and the extremely compressed endocarp.

Certain species of *Pandanus* constitute the chief food plants of the Tuamotu Islands and other coral islands of the Pacific. (See p. 33.) The drupes of this species are edible, the basal half (mesocarp) being thick and fleshy. It is rich in starch and sugar and has a sweetish nutlike flavor.

While not commonly eaten raw on account of the objectionable irritating properties, it is prepared for immediate use by boiling, roasting on fire or in the native oven. It is preserved for future use by pounding to a meal and drying. It is also fermented to make an intoxicating drink. The seeds are small but edible. The drupes are seldom used for making leis (*hei*) or wreaths, as is the custom on the high islands, on account of their great value in furnishing food.

Common in shrubby vegetation along the shore of Katiu; not collected on any other island. The native name is *tima* on Katiu.

4. *Pandanus tuamotensis*, new species (fig. 10).

Drupes, broadly cuneate, convex at the apex, free in the upper third, $7 \pm$ cm. long, $3.5-6 \pm$ cm. broad, tapering from above the center to a blunt, cuneate base, irregularly pentagonal in cross section, compressed in some specimens; locules 7-12, convex at the apex and scarred by corky lines, the outer locules large; apical sutures prominent but shallow; lateral sutures narrow and deep; stigma erect or oblique, slightly protruding, apical or subapical in position; endocarp dorsiventrally compressed, located at the center or approximately two-thirds above the center, nearly as broad as the drupe, biconvex, 2-3 + cm. in thickness, the upper surface irregularly rounded and more or less directed upward at the sides, thick-walled, rimose; apical mesocarp approximately the same apical thickness as the endocarp, traversed with stiff fibrovascular strands separated by wide intrafascicular cavities with more or less intrafascicular pith; basal mesocarp succulent, traversed by rather slender fibrovascular strands, imbedded in thin-walled parenchyma richly stored with starch, sugar, and proteids; seeds small $12 \pm$ mm. long, $5 \pm$ mm. wide; testa white; endosperm abundant, stored with oil and aleurone.

4a. *Pandanus tuamotensis* F. Brown var. *typica* (fig. 10, a).

Stigma erect or oblique, slightly protruding, suborbicular-reniform in shape, $3 \pm$ mm. in diameter; endocarp central, $3 \pm$ cm. in thickness, acutely directed upward at the margin; apical mesocarp not distinctly divided into locular chambers, the air cavities large with little or no pith; basal mesocarp succulent, traversed by rather slender fiber strands $0.4 \pm$ mm. in diameter.

Tuamotu Islands, northwestern part, Takapoto, W. B. Jones, no. 1021, type.

Endemic in Takapoto.

4b. *Pandanus tuamotensis* F. Brown var. *locularis* (fig. 10, b).

Small tree 3-4 meters in height, 5-8 cm. in diameter breast high; locules $11 \pm$, apical sutures with prominent corky edges; stigma oblique, cordate in shape, $4 \pm$ mm. in diameter; endocarp placed approximately two-thirds of its axial length in the apical portion of the drupe, irregularly biconvex in shape, slightly directed upward at the margin, $23 \pm$ mm. in thickness; apical mesocarp distinctly divided into locular chambers, traversed with coarse fibrovascular strands separated by intrafascicular cavities and thin-walled pith; basal mesocarp rather succulent, traversed by fibrovascular strands 0.5 mm. in diameter.

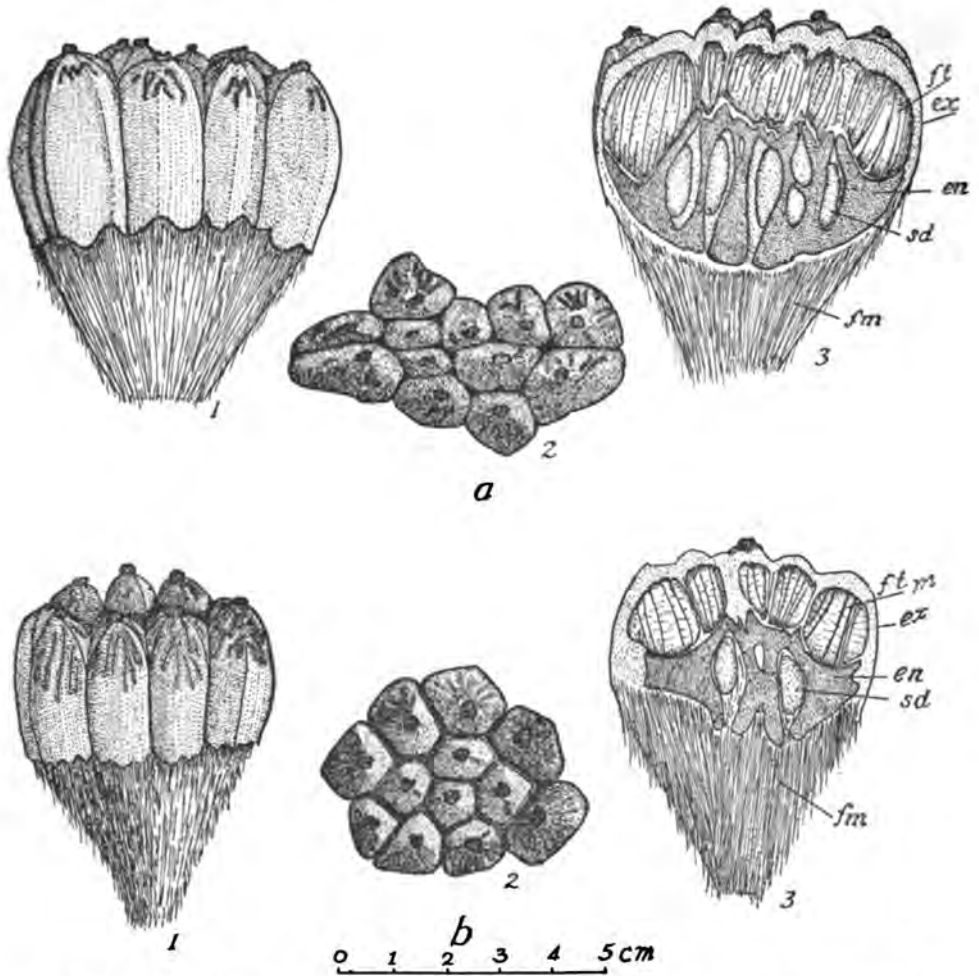


FIGURE 10.—Drupes of coral island types of *Pandanus*: *a*, *P. tuamotensis* var. *typica*; *b*, *P. tuamotensis* var. *locularis*: 1, lateral view; *en*, endocarp; *ex*, exocarp; *fm*, fleshy basal mesocarp; *ft*, floating tissue (apical mesocarp); *sd*, seed; 2, apical view; 3, longitudinal section.

Tuamotu Islands, northwestern part, Tikei, August 31, 1922, W. B. Jones, no. 1052, type. Endemic in Tikei, at an altitude of 4 to 5 meters.

The species is closely allied to *P. katensis* of Katiu, situated southeast of Tikei, in the northwestern portion of the Tuamotu Islands. Both *P. katensis* and *P. tuamotensis* are very closely allied to *P. rockii* of Palmyra Island and somewhat more distinctly to *P. carolinianus* of the Caroline Islands. The native uses are the same as for *P. katensis*.

5. *Pandanus schizocarpus*, new species (fig. 11, a).

Drupes broadly cuneate, irregularly pentagonal in cross section, convex at the apex, 7.5 cm. long, 4-7 cm. wide, free but not divergent in the upper third, composed of 9-16 locules; locules irregularly concentric in arrangement, variable in length, diameter, and cross section outline, very convex at the apex; apical sutures with deep, narrow furrows separating the carpels to or near to the endocarp; lateral sutures deep, narrow; stigma narrowly hippocrepiform, $5 \pm$ mm. long, $3 \pm$ mm. wide, very oblique, slightly protruding or beaklike, subapical or apicolateral in position; endocarp placed at the center of the drupe, dorsiventrally compressed, irregularly rounded above, flat at the base, with upwardly rounded sides, nearly as broad as the drupe, $3 \pm$ cm. thick, osseous, thick-walled, rimose; apical mesocarp $2 \pm$ cm. in axial dimensions, divided into distinct locular chambers, traversed by coarse fibrovascular strands, separated by wide intrafascicular cavities, containing little or no pith; basal mesocarp rather abundant, $2 \pm$ cm. in axial length, traversed by very slender fibrovascular strands 0.2-0.1 mm. in diameter, imbedded in succulent thin-walled parenchyma stored with starch and sugar; seeds small, broadly ellipsoidal, $12 \pm$ mm. long, $7 \pm$ mm. wide; testa white; endosperm abundant, composed of oil and aleurone.

Tuamotu Islands, western part, Tikahau, E. H. Quayle, July, 1923, no. 2191 A, type.

A very distinct species, characterized by the very broadly cuneate 9-16-locular drupes, not contracted at the apex, with deep lateral and apical sutures, and very oblique apicolateral stigmas. The native uses are the same as for *P. katensis*. Endemic in Tikahau.

6. *Pandanus rapensis* F. Brown, new species (fig. 9, c).

Syncarpium subglobose-ellipsoidal in shape, $10 \pm$ cm. in diameter; drupes $37 \pm$, sub-turbinate in shape, irregularly 3-5 + sided in cross section; $4 \pm$ cm. long, $3.5 \pm$ cm. wide, convex above, constricted near the base, shortly stalked, in contact with each other nearly the entire length; carpels 6-9 +, concentric in arrangement, subequal in size, convex at the apex, protruding at the sides; apical and lateral sutures defined by shallow furrows; stigmas subapical in the central carpels, outwardly eccentric in the outer carpels, broadly ovoidal in outline, inequilateral, deeply cordate at the base, $7 \pm$ mm. in length, $4 \pm$ mm. broad, oblique, slightly protruding; exocarp thin, $0.2 \pm$ mm. in thickness, submembranous in texture; apical mesocarp abundant, extending to within 1.5 cm. of the base of the stalk, indistinctly divided into locular chambers at the apex and base, fused at the sides, composed of numerous fibrovascular strands with narrow intravascular cavities and little or no pith; basal mesocarp not developed; endocarp small, turbinate, $1 \pm$ cm. long, basal in position.

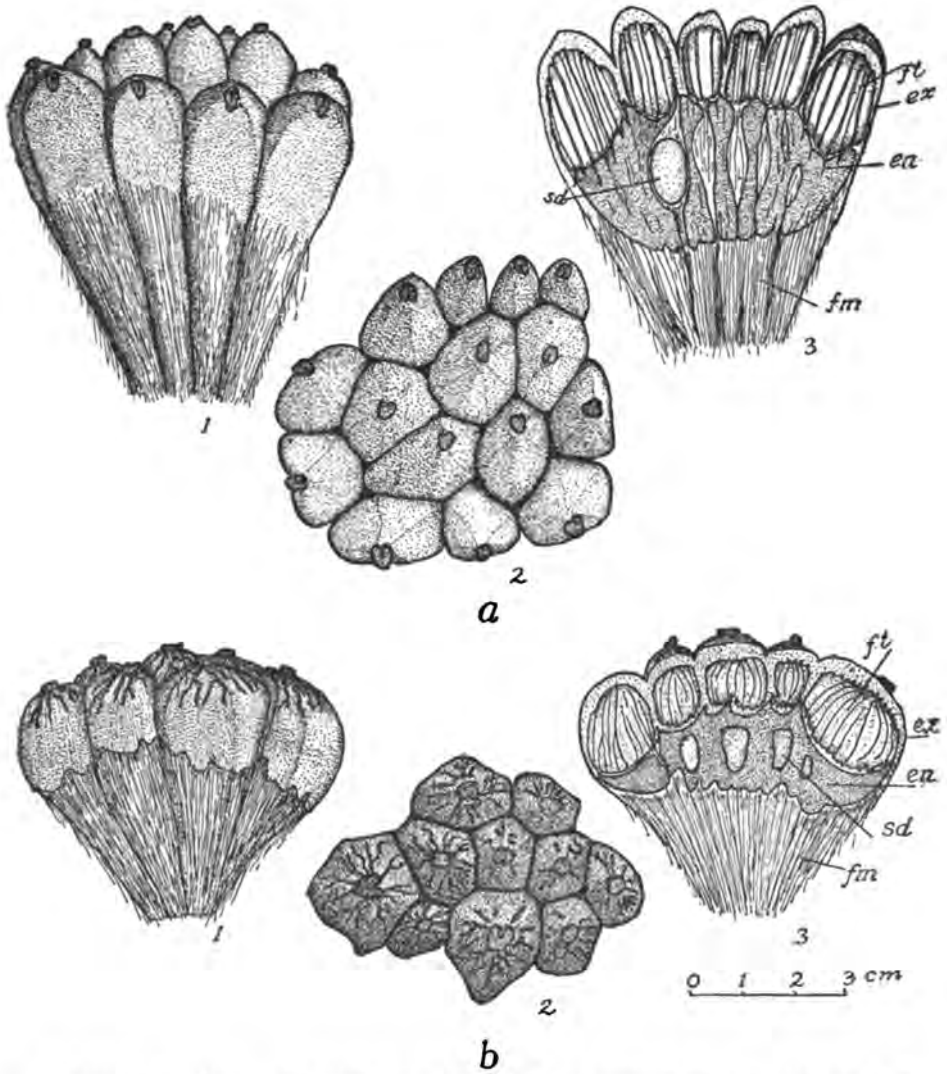


FIGURE 11.—Drupe of coral island types of *Pandanus*: a, *P. schizocarpus*; b, *P. katensis*: 1, lateral view; en, endocarp; ex, exocarp; fm, fleshy basal mesocarp; ft, floating tissue (apical mesocarp); 2, apical view; 3, longitudinal section.

Rapa, E. H. Quayle, no. 369, type.

A distinct species, characterized by the abundantly developed apical mesocarp and basal position of the endocarp; approaches somewhat *P. vieillardii* and *P. macrocarpus* (section *Hombroonia*) of New Caledonia.

On account of their peculiar structure, the drupes contain little edible substance. Formerly, the brace roots furnished fiber for cordage, and the leaves were used for thatch. Endemic in Rapa, where the native name is *ka'ara*.

FAMILY 2. GRAMINEAE

Herbs; rarely shrubs or trees; stems subterete; leaves commonly linear, sheathing the stem, and ligulate at the junction of the blade with the sheath; inflorescence terminal, paniculate, racemose, or spicate; flowers small, without perianth, monosporangiate or bisporangiate, grouped in spikelets composed of three or more concave glumes; lower one or more glumes empty; upper one or more clasping a palea, which encloses a single flower; two minute scales (lodicles) commonly present as part of the flower; stamens commonly 3; anthers versatile; ovulary superior, unilocular, uniovulate; fruit a caryopsis; endosperm starchy, not completely surrounding the embryo.

The Gramineae are by far the most prominent plants in the Marquesan coastal vegetation. The indigenous species cover the rocky seaward slopes from near sea level to an altitude of more than 900 meters, but are almost absent from the moist inland vegetation. The grasses of the interior are mainly species introduced either accidentally or purposely by the early inhabitants; others were brought by the European discoverers.

The coastal grasses, known as *moku tai* by the natives, distinguish the vegetation of the Marquesas from that of other islands in the Pacific. The physical conditions, which seem to have aided the establishment and evolution of the coastal grass associations of these islands, are apparently the result of wave erosion. The land throughout the coast line is being cut away by the direct action of the heavy surf, there being no coral reefs or barriers of any kind to resist the impact of the waves before they break on the shore. As this process continues, the rock is rapidly undermined at sea level until enormous masses cleave vertically and plunge into the sea, carrying whatever vegetation grows upon them. Thus precipitous cliffs, 100-800 + meters in height are formed, which render extensive areas bordering the sea inaccessible in nearly all places outside the bays.

It is unlikely that the unstable seaward slopes have ever been covered with forest during the geological time in which surf erosion has been in progress; surf erosion, being so rapid, only a few pioneer woody plants have time to gain a foothold before a fresh landslide carries the entire vegetation of the

undermined area into the sea, making it necessary for plant invasion to begin anew.

Endemic light-requiring grasses (*Pennisetum* spp. and *Eragrostis* spp.) are remarkably adapted to such conditions, and some spring up on each newly denuded area, where all species form low tussocks, clothing the seaward walls of the cliffs from near sea level to the cloud-capped summit. Their long wiry roots not only anchor the tussocks firmly to the face of the cliffs, but penetrate deeply to the inner moisture of the rocks. The narrow, tightly convolute leaves with thick epidermis are strengthened internally by strands of flexible fibers. Foliage of this kind is highly resistant to the mechanical effect of the heavy winds and storms and to the drying effect of the intense heat of the sun, and enables the firmly rooted tussocks to remain green even during periods of drought. As one approaches the islands of the group, the tussock grass association is the most conspicuous element of the picturesque vegetation, softening the otherwise austere grandeur of the landscape.

Under existing conditions, the *Pennisetum-Eragrostis* association may be regarded as the temporary climax of the coastal cliffs. Probably the entire life history of this association has been closely linked with the geological history of the ever-changing coast line of the islands, and indirectly with the factors responsible for the rapid surf erosion, which undermines every slope as rapidly as vegetation becomes established upon it. The length of time which these factors have been in continuous operation is indicated by the characteristic plants of the association. The unbroken series of *Pennisetum*, together with other features of the vegetation, seem to indicate that coastal erosion has been active through a considerable portion of the late floral history of the Marquesas.

The Marquesan grasses fall into three main groups:

1. Indigenous species—species which have reached the Marquesas by other than human agencies. They are of probable American origin, are chiefly endemic, have near relatives on the Islands, and occur in the original vegetation. They include: *Pennisetum henryanum typicum* and the varieties *pluristylum* and *longisetum*; *P. simeonis* and the varieties *intermedium*, *pedicillatum*, and *purpureum*; *P. articulare*; *P. marquisense*; *Eragrostis marquisensis*, and *E. xerophila*.

2. Species doubtless of aboriginal introduction. These are chiefly of Asiatic origin. Many are cosmopolitan. They are absent from the indigenous vegetation of the islands, but occur in places formerly cultivated by the natives or on the site of ancient native plantations in the remote interior. Such species have few if any close relatives on the islands. Certain species—the sugar cane and bamboo—were intentionally introduced for cultivation. Through efficient cultural methods practiced in native agriculture, numerous

well-defined varieties originated. Apparently many weeds and species of no use to the native, for example, *Andropogon* (*Chrysopogon*) *aciculatus*, were unintentionally introduced in the Marquesas, as in nearly all other high islands of Polynesia. They became naturalized and aid in tracing the path of ancient Polynesian migration. Although the natives are particularly well acquainted with such grasses and have given them appropriate native names, they seem to have forgotten or failed to observe the fact that they were introduced. Among the grasses of aboriginal introduction are 8 Asiatic or pantropic species (*Andropogon* (*Chrysopogon*) *aciculatus*; *Erianthus floridulus*, *E. maximus*, *Saccharum officinarum*, *Oplismenus compositus*, *O. setarius*, *Panicum prostratum*, *Cenotheca lappacea*, and *Schizostachyum glaucifolium*) and 1 American species (*Aristida subspicata*).

3. Species of modern introduction. Mainly cosmopolitan. In the Marquesas they are more numerous near trading ports and have not, as a rule, spread far inland. It is remarkable how accurately the native Marquesans distinguish between and remember the plants introduced since discovery of the islands by the Europeans. These plants bear no ancient native name and play no part in the native usages. They include 1 Asiatic species (*Coix lachryma jobi*); 1 African (*Panicum maximum*); and 13 cosmopolitan species and varieties (*Cenchrus echinatus* var. *hillebrandianus*, var. *pennisetoides*, and var. *glabratus*, *Chaetochloa verticillata*, *Syntherisma pruriens*, *Paspalum conjugatum*, *P. distichum*, *P. paniculatum*, *Eragrostis amabilis*, *E. pilosa*, *Eleusine indica*, *Dactyloctenium aegyptiacum*, and *Cynodon dactylon*).

These lists indicate that all grasses known to be indigenous to the Marquesas appear to be of American origin and that those brought by the natives are of Asiatic origin, with a single American exception. Although it appears that the main stream of Polynesian immigration came from the west, just the opposite direction from which the indigenous flora came, undoubtedly some intercourse may have occurred between the natives of the American continent and those of the Marquesas.

KEY

- | | | |
|--|-----|-----------------------|
| 1. Shrubs or trees; florets with six stamens..... | 27. | Schizostachyum |
| 1. Herbs, florets with three or less stamens (2) | | |
| 2. Florets monosporangiate or bisporangiate, the carpellate
florets enclosed in a hard, beadlike capsule..... | 1. | Coix |
| 2. All or part of the flowers bisporangiate (3) | | |
| 3. Spikelets enclosed in a burr..... | 10. | Cenchrus |
| 3. Spikelets free (4) | | |
| 4. Spikelets with long bristles or hairs at the base, as long as spikelets or longer (5) | | |
| 4. Spikelets without long hair or bristles at the base or, if present, not prominent (9) | | |
| 5. Spikelets with scabrous bristles at the base (6) | | |
| 5. Spikelets with silky hairs at the base (7) | | |
| 6. Bristles numerous, verticillate..... | 9. | Pennisetum |

6. Bristles few, not verticillate.....	13.	Chaetochloa
7. Awn-bearing glumes present (8)		
7. Glumes without awns.....	8.	Saccharum
8. Rachis articulate.....	7.	Erianthus
8. Rachis not articulate.....	6.	Miscanthus
9. Awn-bearing glumes present, the awns easily visible without a lens (10)		
9. Glumes without awns or, if present, minute (11)		
10. Awns, three-branched.....	18.	Aristida
10. Awns, unbranched (20)		
11. Branches of inflorescence paniculate (12)		
11. Branches of inflorescence radiate or simple and lateral or contracted (15)		
12. Surface of upper glume with prominent reflexed hairs near the base.....	21.	Cenotheca
12. Upper glume glabrous or minutely pubescent (13)		
13. Spikelets elongated (14)		
13. Spikelets hemispherical.....	16.	Paspalum
14. Spikelets two to several-flowered (23)		
14. Spikelets one to two-flowered (21)		
15. Spikelets plano-convex (16)		
15. Spikelets laterally compressed or subterete (17)		
16. Branches of panicle unequal.....	15.	Syntherisma
16. Branches of panicle subequal, few.....	16.	Paspalum
17. Spikelets several-flowered (18)		
17. Spikelets one-flowered (27)		
18. Rachis deeply trough-shaped.....	17.	Thuarea
18. Rachis not deeply trough-shaped (26)		
20. Fertile glume clasping the palea (22)		
20. Palea free in the apical portion.....	12.	Echinochloa
21. Spikelets partly included in the concavity of the internode.....	26.	Lepturus
21. Spikelets free.....	14.	Panicum
22. Three glumes.....	19.	Agrostis
22. Four glumes (24)		
23. Spikelets nearly as broad as long.....	22.	Briza
23. Spikelets relatively narrow.....	20.	Eragrostis
24. Spikelets in irregular fascicles.....	11.	Oplismenus
24. Spikelets in twos at each node of the rachis (25)		
25. Spikelets two-flowered.....	4.	Ischaemum
25. Spikelets one-flowered (28)		
26. Rachis prolonged beyond the spikelets.....	24.	Dactyloctenium
26. Rachis not prolonged beyond the spikelets.....	23.	Elesusine
27. Inflorescence contracted, spikelike.....	2.	Zoysia
27. Branches of inflorescence radiate.....	25.	Cynodon
28. Racemes reduced to a single joint.....	5.	Rhaphis
28. Racemes of several joints.....	3.	Andropogon

TRIBE 1. MAYDEAE

Spikelets 1- or 2-flowered, monoecious. The only representative of this tribe in the Marquesas is the recently introduced *Coix lachryma jobi* Linnaeus. Indian corn (*Zea mays* Linnaeus) is not cultivated, the soil and climate being unfavorable.

COIX Linnaeus

1. *Coix lachryma jobi* Linnaeus (Pl. I, C).

Annual, $1 \pm$ meter high; lamina of leaves lanceolate $25 \pm$ cm. long by $2 \pm$ cm. broad, scabrous above and on the margin; spikelets in pairs, monoecious, the staminate spikelets at the summit of the branches the carpellate spikelets below, enclosed in a light-gray, beadlike, woody capsule 1 cm. long.

Marquesas, Nukuhiva, Taiohae, September 1, 1921, F. Brown, no. 675, reference type.

Frequent in all inhabited valleys of the Marquesas where it has escaped from cultivation; doubtless brought by the Catholic missionaries, who used the beadlike capsules for making rosaries. Occasionally they are used for leis, although native Polynesian plants are greatly preferred.

TRIBE 2. ZOYSIEAE

Spikelets 1-flowered; flowers bisporangiate.

2. *ZOYSIA* Willdenow

Stem short, much branched; leaves at close intervals along the stem; blades acicular; spikelets small, without awns, small, 1-flowered, sessile and appressed to the non-articulate rachis; glumes 2; styles 2; stigmas elongated. Monotypic.

1. *Zoysia pungens* Willdenow.

Glabrous perennial with compact dark green foliage; stems $15 \pm$ cm. in height, with long, creeping rhizomes; blades $2 \pm$ cm. in length; ligule short, $0.5 \pm$ mm. in length, thin, ciliate; sheaths short, $7 \pm$ mm. in length; inflorescence spikelike, $2-3 \pm$ cm. in length; spikelets ovoid, 3-4 mm. in length; outer glume smooth, subacute; flowering glume commonly short, hyaline.

Distributed throughout tropical Asia and Malaysia, Ceylon, Mauritius, Australia, New Zealand, and Rapa. Not collected in the Marquesas. Collected at low altitude in Rapa by Stokes.

TRIBE 3. ANDROPOGONEAE

Spikelets commonly in pairs, rarely in threes (*Rhaphis*), with 1 sessile bisporangiate flower and 1 or 2 pedicellate staminate or bisporangiate flowers; commonly 1-flowered; three outer glumes.

3. *ANDROPOGON* Linnaeus

Perennials or annuals; inflorescence composed of one or more spikelike branches from the upper portion or end of the culm; rachis articulate; spike-

lets two at each node of the rachis of which one is sessile and bisporangiate and the other pedicellate and mono- or bi-sporangiate; glumes 4; glume no. 1 empty, as large as or larger than the others, not awned in the fertile spikelet; glume no. 2 empty, with or without an awn; glume no. 3 relatively small, hyaline, empty or, rarely, with a palea and flower in the axil; glume no. 4 commonly 2-parted at the apex, hyaline, provided with an awn, as a rule, in the sessile spikelet; palea present or absent; 3 stamens; 2 styles; stigmas plumose; caryopsis free or partly free within the glumes.

Over 370 species have been reported of which the highest number ($150 \pm$) is credited to Africa; well represented in North America and South America by $100 \pm$ species; $80 \pm$ species in Asia or the East Indies; 15 in Australia; 5 in Madagascar; 5 in the Mascarene Islands; 1 or more in the Moluccas, New Caledonia, Timor, and Bourbon.

1. **Andropogon contortus** Linnaeus.

Heteropogon contortus (Linnaeus) Beauvois.

Fourth glume reduced to an awn 5-10 cm. in length.

Pantropic; credited to the Society Islands by Drake (14, p. 258); not collected in the Marquesas.

2. **Andropogon refractus** R. Brown.

Inflorescence subpaniculate; sessile spikelets 5-6 mm. in length; fourth glume emarginate or 2-lobed, aristate or nonaristate, ciliate.

Distributed in New Caledonia and Fiji; credited to the Society Islands by Drake (14, p. 258); not collected in the Marquesas.

4. **ISCHAEMUM** Linnaeus

Annual or perennial herbs; spikes one or more in number, sessile or borne on short pedicels from the end of a culm; rachis jointed, brittle at the nodes, the internodes concave at the end; spikelets in twos at each node of the rachis, one pedicellate, the other sessile, the sessile one always composed of two florets, deciduous with but not from the internode of the rachis, the inferior flower bisporangiate or staminate, the superior flower bisporangiate; pedicellate spikelet commonly 2-flowered, deciduous from the pedicel. Sessile spikelet: glume no. 1 empty, acute, nonaristate, flat or somewhat depressed on the dorsal surface, bicarinate, the sides inflexed, clasping the edges of the second glume; glume no. 2 empty, carinate, aristate, glume no. 3 fertile, clasping a palea and a staminate or bisporangiate flower, relatively thin, acute, not aristate; glume no. 4 fertile, clasping a 2-veined or enervate palea as long as or

longer than the glume and a bisporangiate floret, thin, aristate from the sinus of the 2-lobed apex; 3 stamens; 2 styles; stigmas plumose, as long as or longer than the styles.

The genus is represented by $42 \pm$ species centering in Asia and Malaysia ($21 \pm$ species); 7 species in Australia; 1 or more species in America, Africa, New Caledonia, Ceylon, Borneo, Madagascar, Bourbon, Hawaii, Tanna, and Riu-Kiu (Lutschu).

KEY

1. Outer glumes scabrous or glabrous..... *Ischaemum stokesii*
2. Outer glumes pilose on the back..... *Ischaemum lutescens* (Brown, 7)

1. *Ischaemum stokesii*, new species (Pl. II).

Culm glabrous, rather slender, $60 \pm$ cm. in height, perennial from a short rhizome $5 +$ mm. in diameter and from the prostrate root-bearing nodes at the base of the culm; lower internodes several in number, $2 \pm$ mm. in diameter, compressed, channeled on one side; upper inflorescence-bearing portion of the culm cylindrical, 1 mm. in diameter; nodes bearded; leaf blades $10-25 +$ cm. in length, $2-5 +$ mm. in width, flat or convolute, smooth on the margins, the surface minutely scabrous when young, coriaceous; veins numerous, prominent, with the midvein slightly thicker than the secondaries; ligule $5 \pm$ mm. in length, glabrous; sheaths 10 cm. in length, glabrous, the veins numerous and prominent; spikes 2, rather thick, $9 \pm$ cm. in length, hairy, erect, one sessile, the second on a pedicel 7-10 mm. in length; internodes of the rachis similar to the pedicels, triangular, two-thirds the length of the sessile spikelet, thick, stiff, cup-shaped and obscurely tridentate at the end, $1 \pm$ mm. in diameter, bearded on the angles with numerous yellowish hairs as long as the internode, the sides glabrous. Sessile spikelet $8 \pm$ mm. in length; first (outer) glume lanceolate in outline, $6 \pm$ mm. in length, thick, coriaceous, flat or slightly convex on the outer surface, scabrous-puberulous on the upper portion, subglabrous below, $1.5 \pm$ mm. in width, bicarinate, minutely spinulose-serrate along the upper portion of the keels, the sides $4 +$ mm. wide, clasping the second glume, the callus-like base 1.5 mm. in length, glabrous on the face, hairy at the sides; second glume coriaceous, hyaline, boat-shaped, 1-veined or obscurely 3-veined, 5 mm. in length, ciliate on the keel, terminating in a straight awn of 5-7 mm; third glume ovate, 3.5 mm. in length, hyaline, obtuse or, when the sides are directly inward, acute, without awn, 3-veined; fourth glume 3 mm. in length, broad, hyaline, glabrous or with $3 \pm$ long ciliate hairs terminating each lobe, the sinus of which extends to near the middle of the glume, where an awn $20 \pm$ mm. is attached; paleas 2, the inferior one in the axil of the third glume, ovate-lanceolate, acute, 2-veined, minutely spinulose-serrate on each keel, the sides broad, overlapping; superior palea $3.5 \pm$ mm. in length, triangular, bicarinate, minutely spinulose-serrate on the keels; hyaline; flowers two in number, one in the axil of the third glume not maturing, or with stamens and ovulary maturing, the second flower in the axil of the fourth glume, commonly fertile; stamens 3; anthers linear oblong, versatile; styles 2 in number, $1.5 \pm$ mm. in length, separate to near the base; stigmatic branches plumose, brownish purple, $3.5 \pm$ mm. in length; caryopsis broadly ellipsoidal, $2 \pm$ mm. in length; embryo nearly one-half the length of the caryopsis; pedicellate spikelet of nearly the same length as the sessile one, the outer glume 2-lobed at the apex or provided with an awn $2 \pm$ mm. in length, the second glume terminating in an awn of $4 \pm$ mm., the fourth glume with an awn of $20 \pm$ mm.

Rapa, Maraia, altitude 2 meters; January 6, 1922, A. M. Stokes, no. 450, type.

Very closely allied to *I. lutescens* Hackel [*I. byrone* (Trinius) Hitchcock] of Hawaii and the Cook Islands, from which it is readily distinguished by the longer spikes and the hispid (not pilose) outer surface of the outer glumes. *I. foliosum* of New Caledonia, *I. murinum* of Tanna Island, and *I. aureum* of Riu-kiu Island are other close allies.

Endemic in Rapa, where it occurs frequently.

5. RHAPHIS Loureiro

Spikelets terminal, 1-flowered, ternate, the central one sessile and bisporangiate; the lateral ones pedicellate and staminate; racemes reduced to single joint.

1. *Rhaphis aciculata* (Retzius) Desvaux (Pl. I, A).

Andropogon aciculatus Retz.

Chrysopogon aciculatus Trinius.

Perennial, 25 ± cm. high, decumbent at the base, gregarious, turf-forming; leaves crowded toward the base with lamina 5-13 cm. long and 5 mm. broad, greatly reduced in size in the upper part of the culm; upper surface glabrous, minutely denticulate along the margin; sheaths glabrous, pilose at the opening; panicle 4 ± cm. long with stiff, ascending branches, purplish-red; spikelets purple, pilose at the base, ternate at the ends of branches, the middle spikelet (*b*) sessile, persistent, and carpellate, the lateral ones (*a* and *a'*) pedicellate and deciduous; carpellate spikelet 4.5 mm. long, the two outer glumes of nearly equal length, the inferior one bifid at the attenuate apex, ciliate along the margin of the distal portion; second glume with an awn 2 mm. in length, ciliate along the keel in the distal portion; two inner glumes small, hyaline, the distal one with a straight awn (*d*), which projects 5 mm. beyond the spikelet. In the staminate spikelets the lower glume tapers to an awnlike apex 1-2 mm. in length; the remaining glumes awnless.

Marquesas, Nukuhiva, altitude 200 to 300 meters, June 7, 1921, F. Brown, nos. 403 and 673. China, May 17, 1922, F. A. McClure, no. 19134. Austral Islands, Rurutu, altitude 160 meters, February 17, 1921, A. M. Stokes, nos. 92 and 113; March 18, 1921, no. 203. Mangareva, altitude 25 meters, May 2, 1922, E. H. Quayle, no. 453. Reference types.

A native of tropical Asia, it is probably of aboriginal introduction in the high islands of Polynesia, including the Marquesas, Hawaii, Society Islands, Mangareva, Rurutu, Marianas Islands, New Caledonia, New Hebrides, Fiji, and Samoa.

It is one of the most valuable pasture grasses for semiarid situations in the Marquesas and other high islands of Polynesia.

Although its introduction into the Marquesas dates back beyond the memory of the natives, the lack of endemic species or varieties, its presence in the vegetation now covering the ancient plantations, and its absence from the areas occupied by indigenous vegetation indicate that the species is not in-

digenous but perfectly naturalized, having become thoroughly established on the dry uplands throughout the group. In the prairie region of western Nukuhiva its extensive areas of nearly pure growth furnish valuable grazing for horses, cattle, and goats (Pl. XXII). The mature fruits are well suited for dispersal by human agency by reason of a device which works its way into any fabric, in the following manner: when the seed is nearly ripe, the two staminate spikelets (Pl. I) are cut off from the pedicels by a layer of clear-age cells at the base of the spikelet. The remaining fertile spikelet bearing the seed, together with the vacant pedicels, are now easily pulled from the panicle and also a portion of the rachis tissue 2 mm. in length, which is provided with a sharp point and upwardly directed barblike hairs. The barbed awn clings to a tapa garment with sufficient force to pull away the obliquely attached barb, which penetrates the tapa and works its way inwardly by the action of the upwardly directed barblike hairs. In this way the whole structure becomes imbedded, the awn and the pedicel serving to anchor it. The seed is not easily released and remains a long time after the glumes are dried. In this way it may have been unintentionally introduced.

The native name is *kohe kohe* and *oke oke* in the Marquesas; *papapa* or *papapapa* in Tahiti, according to Drake (15, p. 258); *piipii* in Hawaii; *matie* and *piripapa* in Rurutu; *mutia tai* in Samoa, according to Setchell (39, p. 113).

6. MISCANTHUS Andersson

Branches of the panicle not articulate or only slightly so, commonly persistent.

1. *Miscanthus japonicus* Andersson (Pl. I, D).

Erianthus floridulus Schultes.

Perennial, 3 ± meters high, forming compact tufts; stem pithy, nonsacchariferous, with a fibrous outer covering; panicle 20-50 + cm. long, 10 ± cm. wide; leaves linear, 35 ± cm. in length; panicle long, 3 ± cm. broad, glabrous, the margin finely spinose-serrate; ligule long, pilose; sheaths pilose at first, finally glabrous; spikelets mostly in twos, one sessile and articulate with the rachis, the other articulate with a pedicel 1-2 mm. in length, 3 mm. high, with copious yellowish-white hairs not exceeding the awn in length; glumes nearly equal in length, of firm texture; awn-bearing palea small, hyaline, the strong median vein prolonged into an awn exceeding the hairs.

Society Islands, Tahiti, near Papeete, altitude 300 meters, March, 1921, F. Brown no. 245. Marquesas, Hivaoa, Atuona, altitude 500 to 600 meters, November 25, 1921, F. Brown, no. 817a. Samoa, Tutuila, Pago Pago, February 7, 1921, A. J. Eames, no. 19. Society Islands, Tahiti, Pirae-Moua Aorai Trail, August 1-3, 1922, Quayle, no. X; Noha Ravine, Mount Aorai, altitude 300 meters, September 28, 1921, Quayle, no. 83. Rapa, 1921, Quayle, no. 345.

Mangareva, altitude 60 meters, April 26 and May 6, 1922, Quayle, nos. 417 and 418. Tuamotus, Makatea, altitude 100 meters, August 18, 1922, W. B. Jones, no. 872. Austral Islands, Raivavae, altitude 300 meters, March 8, 1922, Stokes no. 9. Rapa, Maria, altitude sea level to 100 meters, July 9, 1921, Stokes, no. 84. Austral Islands, Rurutu, Avera, altitude 170 meters, February 15, 1921, Stokes, no. 130. Rurutu, altitude 120 meters, March 3, 1921, Stokes, no. 100. Reference types.

In some specimens the joints of the panicle branches tend to separate somewhat as in *Erianthus*. For this reason, Drake (15, p. 257) retains *Erianthus* Schultes for this species. However, *Miscanthus* is commonly accepted by recent authors.

In the Marquesas, the outer layers of the flower stems, separated into narrow strips, furnished a beautiful straw for braiding hats; however, the stems of *Erianthus pedicellaris* were selected more frequently for this purpose. In Rurutu and Rapa, the stems were also used in making houses, and a medicinal extract was obtained from the inflorescence. Economically it is of no use, being an undesirable weed.

The native name is *kakaho* in the Marquesas, *kaka'o* in Rapa and Rarotonga, *a'eho* in Tahiti, Rurutu, and Raivavae, and *fiso* in Samoa.

Although indigenous in Japan, China, East Indies, the Philippines, and New Caledonia (?), it is also distributed in islands of the Pacific, where it may have been introduced by the Polynesians: Fiji, Samoa, Rarotonga, Rapa, Rurutu, Raivavae, Marquesas, Society Islands, Mangareva, Makatea, and Tonga.

7. ERIANTHUS Michaux

Branches of panicle articulate, brittle, and deciduous at the nodes when mature and dry; flowers bisporangiate.

The two species, *Erianthus maximus* and *Erianthus pedicellaris*, commonly known as wild sugar cane, which occur in Polynesia, may be classed partly as food plants, for the reason that the tissues of the stem yield a small amount of sugar. Inasmuch as the two species are separated by trivial differences, which are smaller than those used to separate the cultivated varieties of sorghum (*Andropogon sorghum*), it is not improbable that *Erianthus maximus* and *Erianthus pedicellaris* originated as cultivated varieties of the same original species during its cultivation by primitive man.

The outer tissues of the flower-bearing stem split easily into ribbon-like strips, which turn bright-yellow when bleached in the sun. The strips obtained from this species are highly esteemed by the natives for fine weaving, particularly for the braiding of hats, and are considered by them to be far superior in quality to those obtained from the *kakaho* (*Miscanthus*

japonicus) or even from the true sugar cane (*Saccharum officinarum*). The plant served to some extent as a substitute for the sugar cane; also it was used for medicinal purposes, a watery extract from the panicle being mixed with coconut oil and applied externally for colds and headaches. The hats and other articles made from the stem tissues by the natives are of commercial value.

Described originally from Nukuhiva, *E. pedicellaris* is found up to an altitude of 700 meters throughout the Marquesas. The typical form seems not to have been found outside the Marquesas although its occurrence there in isolated areas originally cultivated by the natives suggests aboriginal introduction.

KEY

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| 1. Internodes of rachis subequal to the spikelet. | (2) <i>Erianthus pedicellaris</i> |
| 1. Internodes of rachis longer than the spikelet. | (3) <i>Erianthus maximus</i> |
| 2. Fertile stamens commonly two | 1. <i>Erianthus pedicellaris</i> var. <i>typica</i> |
| 2. Fertile stamens commonly three | 1a. <i>Erianthus pedicellaris</i> var. <i>rapensis</i> |
| 3. Awn 2-4 mm. long | 2. <i>Erianthus maximus</i> var. <i>typica</i> |
| 3. Awn shorter | 2b. <i>Erianthus maximus</i> var. <i>seemanni</i> |

1. *Erianthus pedicellaris* Hackel, var. *typica* (Pl. I, B).

Perennial, 2-6 + meters high; stem sacchariferous except near the center, the outer tissues fibrous and separable in ribbon-like strips; leaves linear, 90 ± cm. long, 3 ± cm. broad, attenuate to a filiform apex, glabrous; ligule 2 ± mm. wide, bordered externally with a fringe of long hairs; panicle 50 ± cm. long; spikelets usually in twos, 4.5 ± mm. long, one on a pedicel one-quarter to one-half shorter than the internode of the rachis, the other on a short pedicel 0.6-0.8 mm. long, or sessile, with numerous silky hairs at the base, commonly over twice the length of the spikelet; glumes of nearly equal length, lanceolate, acute, the outer (fourth) 3-veined; the second 3-veined, very acute, hyaline at the margin; the third 1-veined, hyaline, ciliate, nearly as long as the second and first, ciliate; the fourth about one-third shorter, divided to near the middle into 2 acute apical divisions, ciliate, bearing a nearly straight barbed awn 7-9 mm. in length; palea short, linear oblong, obtuse, ciliate; stamens commonly 2, rarely 3, the anthers 1.5 mm. long.

Marquesas, Nukuhiva, Taiohae, May 20, 1921, F. Brown, no. 385, reference type.

Erianthus pedicellaris seems closely allied to, if, indeed, not confluent with, *Erianthus maximus* of Tahiti, Fiji, and Samoa, which differs in the longer internodes of the panicle branches, exceeding the spikelets in length, and in the shorter awn, 2-4 mm. in length. The native names in the Marquesas are to *kakaho*, to *kakahoa*, and to *kaipeka*.

1a. *Erianthus pedicellaris* var. *rapensis*, new variety (Pl. I, E).

Perennial, 2-3 meters in height, the stem somewhat sacchariferous, thinly pubescent with long, appressed hairs, leaf-bearing to near the panicle; leaves linear, 80 cm. long, 2-3 + cm. broad, smooth except on the margin, pubescent near the ligule; ligule 2 + mm. broad, ciliate-hairy; panicle 40 ± cm. long, the branches sinuate, up to 25 + cm.

long, pilose at the nodes; internodes curved, shorter than or subequal to or rarely somewhat longer than the spikelet, pubescent; pedicel commonly one-half the length of the internodes, subglabrous; sessile spikelet 4-4.5 mm. long, one-half to two-thirds the length of the involucre silky hairs, which are numerous, yellowish-white in color, the pedicel very short ($0.5 \pm$ mm.) or obsolete; first (lower) glume of firm texture, 4 to 4.5 mm. long, acuminate, minutely bidentate, 2-veined, or faintly 3-veined, smooth; second glume slightly shorter and thinner, lanceolate, acute, submucronate, ciliate, 1-veined or faintly 3-veined; third glume hyaline, lanceolate, acute mucronate, ciliate, 1-veined; fourth glume $2 \pm$ mm. long, hyaline, linear-oblong, deeply bidentate, ciliate, provided with an awn $6-8 \pm$ mm. in length, projecting 2-6 mm. beyond the outer glumes; palea hyaline, lanceolate, obtuse, ciliate, $2 \pm$ mm. long; stamens 1-3, the anthers 2 mm. long; ovulary and style 1 mm., the 2 stigmatic branches 1-2 mm. long.

Rapa, Hiri, September 23, 1921, Stokes, no. 212, type; Rapa, Ahurei, June 6, 1921, Stokes, no. 17, reference type.

The inner tissues of the stem contain sugar, which was used as food. The native name is (*pua*) *tamei* in Rapa.

2. *Erianthus maximus* Brongniart (from Hackel in part).

Tall perennial, 2-5 + meters in height; stem somewhat sacchariferous; leaves $70 \pm$ cm. long, $3 \pm$ cm. wide; panicle 30-40 cm. in length; internode of rachis longer than the spikelet; spikelets in pairs, one sessile, the other on a pedicel one-half the length of the internode; sessile spikelets 4-4.5 mm. long, one-half to two-thirds as long as the involucre hairs; first glume thickened, acuminate, glabrous, scabrous on the keel; second glume thin, acute, smooth; third glume lanceolate, acute, mucronate; fourth glume linear, two-thirds the length of the second, glabrous, 1-veined, terminating in an awn 2-4 mm. long; palea one-half the length of the glume, linear, obtuse, ciliate.

2a. *Erianthus maximus* var. *genuinus* Hackel.

Upper part of culm, rachis, and axis of panicle glabrous; awn exerted to one-half its length.

Tahiti; introduced in the Marquesas, according to local informants, but not collected.

2b. *Erianthus maximus* var. *seemanni* Hackel.

Culm, axis and rachis puberulent; fourth glume very narrow; awn slightly exerted. Fiji; Samoa, according to Rechinger (34, pt. 1, p. 105) var.?

8. SACCHARUM Linnaeus

Spikelets in pairs without awns, both sessile or one pedicellate. Approximately 12 species of Asia and Africa.

1. *Saccharum officinarum* Linnaeus (Pl. XXIII, B).

Marquesas, Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 799, reference type.

The native names are: *to* in the Marquesas, Tahiti, and Niue; *ko* in Hawaii; *tolo* in Nukuoro, Caroline Islands. The English name is sugar cane.

The ancient Marquesans cultivated the following 14 varieties, which they distinguished by differences in sugar content, habit of growth, color, length of nodes, and similar characters: *to aniata*, Fatuhiva; *to eva*, Fatuhiva; *to kakamao*, Uapou; *to kaipeka* (term applied also to *Erianthus pedicellaris*), Fatuhiva; *to kua*, Fatuhiva, Uapou and Nukuhiva; *to ma'oi* (stem and foliage green), all inhabited islands; *to kaka mau*, northern islands; *to pau*, Fatuhiva; *to pupuha*, Fatuhiva; *to putoake*, Nukuhiva; *to tapatuki*, Uapou; *to toake*, Uapou; *to toa*, Futuhiva; *to tooniho*, Fatuhiva.

Of these varieties, *to ma'oi*, as indicated by the native name, which interpreted by Dr. Peter Buck signifies "very ancient," has long been cultivated by the Marquesans. Apparently this was the variety brought by them in their early migration to the Marquesas, and from this ancient stock, presumably, the other 13 special varieties have been evolved under native cultural methods.

Besides furnishing sugar, some of these varieties are used by the natives in various ways. *To kua* and *to kakamao* were considered as medicinal plants. The outer tissues of the cane stem are separated into thin, light-yellow ribbon-like strips, which are highly prized for the artistic weaving of hats, fans, and other articles. Hats woven from sugar cane compare favorably with those manufactured in Europe and America.

The commercial varieties of sugar cane, some of which were introduced from Hawaii, are cultivated only to a very limited extent; the Marquesan topography is unfavorable for the growth and harvest of cane on a commercial scale.

Indigenous to southern Asia; doubtless of ancient aboriginal introduction in the Marquesas, where it is cultivated in small areas in every inhabited valley.

TRIBE 4. PANICEAE

Inflorescence spicate, racemose or paniculate; spikelets, 1- or 2-flowered. This is by far the best represented tribe of the Gramineae in the Marquesas. Known as panic grasses.

9. PENNISETUM Persoon

In the Marquesan species of *Pennisetum*, the inflorescence is a terminal cylindrical spike; spikelets sessile or pedicellate, grouped in fascicles of 2, surrounded by an involucre of long bristles; spikelets commonly composed of 2 flowers of which the terminal is bisporangiate and the inferior staminate or vestigial; 4 glumes, the 2 lower ones empty, the third (flowering glume or lemma) embracing the palea of the lower flower, the fourth embracing

the palea of the terminal flower; styles united at the base. A tussock-forming perennial.

The genus comprises 120 species, having a primary concentration of 77 species in tropical Africa and a secondary concentration of 29 species in tropical America. It is more local in distribution than the closely related *Cenchrus*. The general native term applied to all representatives of this genus in the Marquesas is *moku tai* (sea grass), on account of their distribution on the coastal cliffs. They are used by the natives as fillings for temporary beds.

In the Marquesas, the endemic species of *Pennisetum* are closely allied and form an evolutionary series typical of the flora of these islands. Only 3 (4, including the divergent *P. marquisense*) distinct species and 5 varieties or elementary species are represented. This striking series begins with the mesophytic species *P. henryanum* and ends with the xerophytic *P. articulare*. All are adapted to the peculiar climate, soil, and topography of these islands and form a conspicuous element of the flora with the specialized xerophytic types progressively abundant and occupying the exposed, constantly changing face of the high shore cliffs.

In the different species and varieties, the progressive evolutionary tendencies are expressed by (1) a moderate though decided amplification of the glumes, (2) extreme reduction of the transpiration surface, and (3) great increase of sclerenchyma in the tissues. For example, the relatively primitive leaf of *P. henryanum* is broad, thin, and flat, and the specialized leaf of *P. articulare* is convolute, filiform, and thickened with sclerenchyma. Precisely the same evolutionary tendencies are apparent in other associated grasses, such as *Agrostis*, resulting in a remarkably similar growth form in the two genera.

All species and varieties of *Pennisetum* in the Marquesas may have been evolved from one, or perhaps two ancestral immigrants. The progressive reduction in the length of the involucreal bristle and in the stigmatic branches of the style—a distinguishing feature of the Marquesan evolutionary series of the genus—suggests the position of *P. marquisense* near the culmination. This is further indicated in the venation of the glumes, which resembles that of the highly specialized *P. articulare*. The pubescent foliage, retrorse barbs of the bristles, and the presence of two spikelets in the fascicle are divergent characters not present in other members of the series. They seemingly indicate the presence of a divergent side line closely approaching *Cenchrus* and may represent a second ancestral immigration. The superficial resemblance of the fascicle of *Pennisetum marquisense* to the burr of *Cenchrus echinatus* var. *pennisetoicles* is indeed striking, although the bristles of *Pennisetum marquisense* are distinct to the very base, showing no lateral fusion as in *Cenchrus*. The staminate floret is commonly present and functional.

KEY

1. One spikelet within the involucre; bristles antrorsely barbed (2)
 1. Two spikelets within the involucre; bristles retrorsely barbed.
2. Ligule small, glabrous or subglabrous.....1. **Pennisetum marquicense**
Pennisetum henryanum
 2. Ligule prominent, ciliate (3)
 3. Leaves 5 ± mm. broad.....2. **Pennisetum simeonis**
 3. Leaves narrow, 2 ± mm. wide, convolute.....3. **Pennisetum articulare**

1. **Pennisetum henryanum**, new species (Pl. III).

Perennial, tussock-forming grass, 50 ± cm. high, decumbent and freely branching at the base; leaves linear, flat, 35 ± cm. long, 1 cm. broad, minutely spinulose-serrate along the margin, glabrous above and below; ligule an inconspicuous tuberculate ridge, glabrous and subglabrous; sheaths glabrous throughout, loosely clasping or free and continuous with the lamina; spikes cylindrical, 10-13 ± cm. long, 3 ± cm. broad, purplish to light-yellow in color; rachis puberulent; spikelets distinctly pedicellate; the pedicels extending 0.5 mm. beyond the involucre bristles, deciduous with spikelet and involucre; bristles numerous, unequal, the longest 18-25 ± mm. long, or over four times the length of the spikelet; spikelet 4-6 mm. long, composed of 2 subequal flowers, the inferior staminate or empty, the superior bisporangiate; basal glumes 2, empty, mucronate, ciliate on the margin, puberulent, the lower triangular, acute, 2 mm. long, 1-veined; second triangular, obtuse, 3 mm. long, third glume of inferior flower triangular, obtuse, 4 mm. long, 5-veined, mucronate, 7-veined palea of lower flower hyaline; third glume of superior (bisporangiate) flower triangular, acuminate, 4 mm. long, 5-veined; palea of superior flower hyaline, 2-veined, ciliate; style connate, with 2 plumose branches 8 mm. long.

Marquesas, Nukuhiva, Hakaui, June 16, 1921, F. Brown, no. 454, type.

The native names are *mouku pavahina* and *vehe tu tue*. Endemic in the Marquesas; occurs on moist, shaded cliffs, up to an altitude of 800 meters, Nukuhiva.

1a. **Pennisetum henryanum** F. Brown var. **pluristylum**, new variety.

Leaves sharply spinulose-serrate on the margin; style with 3 or 4 plumose branches.

Marquesas, Nukuhiva, Taiohae, June 14, 1921, F. Brown, no. 454 A, type.

Endemic, uncommon, on sea cliffs, in rather exposed situations, altitude 20 to 800 meters, Nukuhiva.

1b. **Pennisetum henryanum** F. Brown var. **longisetum**, new variety.

Similar to species, but involucre bristles up to 25 mm. long, or 6 times the length of the spikelet, purple or yellow; spikes 10-13 ± cm. long, 4 cm. broad; glumes more acute than in species, the second basal glume 4-5-veined; floral glumes 5-veined.

Marquesas, Nukuhiva, July 2, 1921, F. Brown, no. 471, type.

Endemic in the Marquesas, on interior ravine cliffs, at an altitude of 800 ± meters.

2. **Pennisetum simeonis**, new species (Pl. IV).

Culm perennial, erect, 20-60 + cm. high, decumbent at the base; leaves 40 ± cm. long, 5 ± mm. wide, flat or convolute; ligule long, ciliate, prominent; sheaths glabrous

outside, tightly clasping or somewhat open, pilose or subglabrous outside at the opening; spikelets cylindrical, 5-10 + cm. in length, suberect on rather stiff culms 1 ± mm. in diameter; spikelets commonly shortly pedicellate, rarely sessile or both sessile and pedicellate on the same spike; involucre bristles unequal, the longest 2-3 + times as long as the spikelet, purple or light yellow; basal glume about one-half the length of the spikelet, 1-veined; second glume somewhat longer, 3-veined; floral glumes each 5-veined.

This variable species may include the vaguely described *P. flavisetum* Steudel, cited by Drake (15, p. 253). It is named in honor of Simeon Delmas, Taiohae, Nukuhiva, whose kindly and sympathetic interest in procuring and donating specimens is gratefully acknowledged.

Native name and use are the same as those given for the genus. Endemic in the Marquesas, where the numerous varieties form low tussocks (Pl. XXIV) on dry cliffs and slopes of the coast line.

2a. *Pennisetum simeonis* var. *intermedium*, new variety (Pl. IV, A).

Perennial tussock-forming grass with strong leafy culms, decumbent and freely branching at the base, deeply rooted, 60 ± cm. high; leaves numerous, narrowly linear, flat or somewhat convolute, 50 ± cm. long, 6 ± mm. wide, scabrous on both faces; margin and ventral surface of midrib sharply spinulose-serrate; ligule prominent, long-ciliate; sheath long-pilose at the clasping margin, glabrous on the surface; spikes cylindrical, erect or slightly nodding, 10 ± cm. long, 2 ± cm. broad, purple or yellowish; rachis hispid-puberulent; spikelets and involucre sessile and deciduous, the spikelets 5-6 mm. long; involucre bristles numerous, unequal, 1-15 mm. long, up to 3 times the length of the spikelet, purple or light-yellow, hispid; spikelets composed of 2 subequal flowers, the superior bisporangiate, the inferior staminate or vestigial; glumes puberulent, abruptly acuminate, awnlike at the apex; lower glume 2 mm. long, 1-veined; second glume 4 mm. long, 3-veined; third (flowering) glume 5 mm. long, 5-veined; palea hyaline, 5 mm. long; style branches 5 mm. long, exerted, united for a distance of 1 mm. near the base.

Marquesas, Nukuhiva, 1922, Simeon Delmas, no. 41, type.

Endemic; common, forming compact tussocks on coastal cliffs and steep slopes from near sea level to an altitude of 800 meters.

2b. *Pennisetum simeonis* F. Brown var. *pedicellatum*, new variety (Pl. V).

Pennisetum articulare Trinius: Drake (15, p. 253, in part).

Culms 20-40 + cm. high; lamina of leaves 20 ± cm. long, 4 ± mm. wide, scabrous on the margin and on the lower surface; ligule prominent, fringed with long hairs; sheaths glabrous throughout; spikes cylindrical, 5-10 ± cm. long, bright-yellow at maturity, suberect on rather stiff culms 1 mm. in diameter; spikelets pedicellate, the pedicels extending 1 mm. beyond the base of the involucre and deciduous with the spikelet from the rachis; involucre bristles light-yellow, unequal, the longest about 3 times the length of the spikelet, the inner series of bristles are much thicker than the outer, and some of them bear near the base 1 to several long hairs 1 ± mm. long; glumes typical of the species; style branches short, the plumose portion 4 mm. in length.

Marquesas, Uahuka, April 24, 1921, F. Brown, no. 360, type. Hivaoa, Père Simeon Delmas, no. 12, reference type.

Endemic in the Marquesas, common on dry slopes and shore cliffs, altitude 15 to 500 meters.

2c. *Pennisetum simeonis* F. Brown var. *purpureum*, new variety.

Stems $40 \pm$ cm. high; lamina of leaves 20-40 cm. long, $4 \pm$ mm. wide when spread flat, but commonly tightly convolute in roll $1 \pm$ mm. in diameter, scabrous on the dorsal surface and on the margin, but subglabrous on the ventral surface; ligule prominent, fringed with long hairs; sheath glabrous throughout, with hyaline margin; spikes cylindrical, $8 \pm$ cm. in length, suberect on scabrous culms 1 mm. in diameter, purple; spikelets shortly pedicellate, the pedicels extending barely 0.5 mm. beyond the base of the involucre, separating from the rachis with the spikelet; bristles unequal, the longest about three times the length of the spike, purple or yellowish in color; venation of glumes typical except that the upper basal glume is distinctly 3-veined or indistinctly 5-veined; style branches short as in var. *pedicellatum*.

Marquesas, Hivaoa, dry slopes and coastal cliffs, Simeon Delmas, no. 12a, type.

This variety is transitional and closely connects the species with *P. articulare*.

3. *Pennisetum articulare* Trinius (Pl. IV, B).

Pennisetum identicum Steudel: Jardin (24, p. 27).

Culms decumbent at base; nodes and sheaths glabrous; ligule prominent, ciliate; lamina of leaves narrowly linear, 15-25 + cm. long, $2 \pm$ mm. broad when unrolled but commonly tightly folded upward and convolute, subfiliform, and less than 1 mm. in diameter; slightly scabrous on the dorsal surface and on the margins; spikes 4-5 cm. in length, nodding on slender wiry stems less than 0.6 mm. in diameter; rachis puberulent; spikelets and involucre sessile, deciduous with involucre, 5 mm. long, composed of 2 flowers, of which the upper is bisporangiate and the lower is staminate or vestigial; glumes acute and more or less mucronate; first (basal) glume about half the length of the spikelet, 1-veined; second glume slightly larger, 3-veined; floral glume 5 mm. long, 5-veined, acuminate; style relatively short, united at the base for a distance of 1 mm., the plumose branches 4-5 mm. long; bristles of the involucre of unequal length, the longest 2-3 times the length of the spikelet, hispid, commonly light-yellow.

Marquesas, Nukuhiva, southern part, June 20, 1921, F. Brown, no. 430; Nukuhiva, Hakau, June 10, 1921, F. Brown, no. 777; reference types.

This is the most xerophytic and highly specialized in habit and anatomy of all the Marquesan species belonging to this genus. The native name is *haiki kuhane*; the common English name is sea grass. Economically this species may serve as a ground cover for exposed rocky situations.

Endemic in the Marquesas; common on shore cliffs throughout the archipelago, where it forms low tussocks $30 \pm$ cm. tall from sea level to an altitude of 900 meters, thriving on exposed vertical cliffs where few other plants grow.

4. *Pennisetum marquisense*, new species (Pl. V, A).

Perennial; culms erect or ascending from a decumbent branching base, forming compact tussocks $40 \pm$ cm. high, long pilose, especially in the upper portion; lamina of leaves narrowly linear, involute or flat, 5-15 + cm. long, 4 + mm. wide; veins prominent and sclerous; the margin is scabrous; surfaces thinly covered with long hairs; ligule

densely ciliate, 1-2 mm. in length; sheaths strongly keeled, overlapping, pilose on the outer surface and near the ligule, the margins hyaline; spike narrowly cylindrical, $4 \pm$ cm. long and $1 \pm$ cm. broad, the rachis pilose; fascicles subsessile, the bristles short, little if at all exceeding the spikelets, the inner series subequal, about 4.5 mm. in length, stout, $0.4 \pm$ mm. in diameter, hairy and yellow in color in the lower half or three-fourths, tapering into a retrorsely barbed apex; outer series unequal, awnlike, retrorsely barbed; spikelets 2 in each fascicle, 4.5-5 + mm. high, each fascicle composed of a single terminal bisporangiate floret and commonly a second staminate flower below it; first (lower) glume 1-veined, 2 mm. high; second glume acute, 3 mm. high, 3-veined; third glume acute, 4.5 mm. high, 5-veined, with a 2-veined staminate palea in the axil, partly enclosing the fourth glume; fourth glume 4.5 mm. high, indurated, 3-veined, nearly enclosing the sclerous palea containing the bisporangiate flower; style branches protruding $3 \pm$ mm. from the apex of the spikelet, united below.

Marquesas, Nukuhiva, Mauu, June 20, 1921, F. Brown, no. 431, type.

Pennisetum marquisense seems closely allied to *P. karwinskyi* Schrader, distributed from the uplands of Mexico to Costa Rica, but is distinguished from it by its smaller size, 2-flowered spikelets, densely hairy inner bristles, and the venation of the glumes. The native name is *pua ta'a ta'a*, the same as for *Cenchrus*, which this species superficially resembles. This distinct species is endemic in the Marquesas, where it forms low tussocks on the coastal and ravine cliffs from sea level to an altitude of $900 \pm$ meters. It is less common and less xerophytic than *P. articulare*.

10. CENCHRUS Linnaeus

Inflorescence terminal, spike-like; spikelets in fascicles of 1-6 + surrounded or partly enclosed by an involucre homologous with that of *Pennisetum*; bristles more or less connate and spinelike, forming a bur, inside of which the seed remains and germinates; glumes 3-4 in number; spikelets commonly 1-flowered, with vestiges of a second floret in the axil of the third glume, which partly includes the functional floret, as in *Pennisetum*; in some cases the spikelet is 2-flowered with an inferior staminate floret.

Cenchrus and *Pennisetum* are closely connected through *Cenchrus echinatus* on the one hand and *Pennisetum marquisense* on the other. The characters which separate these two genera and indicate *Cenchrus* as the more specialized genus are the reduction of the staminate florets and the fusion of the involucre segments. Apparently the wide distribution of *Cenchrus* in the Pacific islands is intimately connected with the evolution of the tenacious bur with its retrorsely barbed spines. This has apparently served as an efficient means of dispersal through human agency, as the genus does not seem to have been present on the islands before the arrival of man.

The native names are *pua pipii* and *pua ta'a ta'a* in the Marquesas; *atiati* in Niau, Tuamotus.

1. *Cenchrus echinatus* Linnaeus.

Annual; culms erect, 30-60 + cm. high, from a decumbent base; lamina of leaves flat, linear, 10-20 + cm. long and 4-7 + mm. wide, slightly scabrous on the margin; ligule ciliate; sheaths ciliate on the margin; spikes 3-8 + cm. long; involucre 6 mm. high, 10 mm. in diameter, containing 2-4 spikelets 5-6 mm. in height; involucre bristles of unequal length, the longest little if any longer than the spikelet, the inner series flattened, connate, pilose on the margins, tapering into a spinelike retrorsely barbed apex, the outer series awnlike, free, very unequal, straight or slightly curved, spreading or ascending, retrorsely barbed; glumes 4, rarely 3, the first 1.5 mm. high, acute, hyaline, 1-veined; second glume acute, 4 mm. high, 5-veined, with a vestigial floret in which the stamens are reduced to staminodia or rarely with a vestigial floret bearing functional stamens; palea 2-veined.

It occurs frequently in open places from sea level to an altitude of 500 + meters in the Marquesas; a pantropic weed of American origin recently or aboriginally introduced in the Marquesas and other parts of Polynesia.

The native names of this species are *pua pipii* and *pua ta'a ta'a* in the Marquesas, without distinction as to variety; *atiati* in Niau, Tuamotus; *vao papalagi* in Samoa.

The following three varieties occur in the Marquesas:

1a. *Cenchrus echinatus* Linnaeus var. *hillebrandianus*, new combination.

Cenchrus hillebrandianus Hitchcock.

Culm, lamina of leaves, and sheaths more or less pubescent; inner bristles of fruit plumose-hairy below, stiff, sharply pointed and barbed at the end.

Reference types with descriptions:

1. Marquesas, Nukuhiva, Mauu, altitude 600 meters, June 20, 1921, F. Brown, no. 437. Bur 10 ± mm. in diameter; outer bristles few, short, 4 ± mm. in length, minutely barbed, slender; inner bristles numerous, 5 ± mm. in length, connate and plumose-hairy below, erect or ascending, free, rather stiff, and minutely barbed above.

2. Hawaii, Oahu, Waikiki, June 19, 1916, A. S. Hitchcock, no. 13801. Bur 10 ± mm. in diameter; outer bristles few, slender, short, 4 + mm. in diameter; outer bristles few, moderately barbed; inner bristles long, 6 ± mm. in length, connate and plumose-hairy below, stiff, free, spreading or erect, and sharply barbed above.

3. Mangareva, Tairavai, altitude 100 meters, May 6, 1922, E. H. Quayle, no. 464. Bur 10 ± mm. in diameter; outer spines few, slender, 3 ± mm. in length, minutely barbed; inner bristles 5 ± mm. in length, connate and plumose-hairy in the lower portion, stiff, sharply barbed, and erect, spreading or recurved at the end.

In the Marquesas this variety approaches *C. hillebrandianus* Hitchcock (21, p. 211) except that the leaves are somewhat longer and the inner bristles of the bur are not as stiff and spreading and are less sharply barbed. Difference in pubescence seems too variable a character to serve as the mark of a distinct species, as Hitchcock assumes, although it vaguely characterizes

local varieties or forms of the same species, which have, to all appearance, developed largely in relation to environment. Seedlings of Hawaiian pubescent plants, observed in an experimental planting, differ greatly from subglabrous to pubescent, according to conditions under which they are grown. The specimens from Hawaii, the Marquesas, and Mangareva are not identical, differing slightly in the bur.

Distributed throughout the dry uplands of the Marquesas; one of the commonest grasses in Mangareva.

1b. *Cenchrus echinatus* Linnaeus var. *pennisetoides*, new variety.

Similar to var. *pubescens*, but the leaves relatively narrow, $5 \pm$ mm. in width; bur small, $5 +$ mm. in diameter; outer bristles rather numerous, unequal, $1-5 \pm$ mm. in length, suberect, slender or somewhat thickened, minutely barbed or plumose-hairy; inner bristles connate in the lower portion or nearly free, $5 \pm$ mm. in length, acutely pointed, plumose hairy in the lower portion and smooth or obscurely barbate at the apex. Form of spike and size and shape of the fascicle resemble *Pennisetum marquisense*. A fairly distinct variety.

Marquesas, Nukuhiva, Hakau, altitude $200 \pm$ meters, July 15, 1921, F. Brown, no. 657, type.

1c. *Cenchrus echinatus* Linnaeus var. *glabratus*, new variety.

Foliage glabrous or glabrate; inner bristles of bur puberulent to hairy in the lower portion; passes into var. *hillebrandianus*.

The reference types with descriptions are as follows:

1. Marquesas, Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 745. Bur $10 \pm$ mm. in diameter, up to $6 \pm$ mm. in length, slender, minutely barbed; inner bristles $6 \pm$ mm. long, connate and somewhat hairy below, free, rather stiff; erect or ascending, minutely barbed above. Common on slopes, from sea level to an altitude of $500 +$ meters.

2. Tuamotus, Niau, August 16, 1922, W. B. Jones, no. 803. Bur $14 \pm$ mm. in diameter; outer bristles rather few, spreading, slender, $4 \pm$ mm. long, minutely barbed; inner bristles connate below and densely plumose-hairy below, stiff, free erect or spreading and minutely barbed above, $6 \pm$ mm. in length.

3. Philippines, Luzon, January, 1909, M. Ramos, no. 5995. Bur $10 \pm$ mm. in diameter; outer bristles numerous, slender, $4 \pm$ mm. in length, minutely barbed; inner bristles connate and puberulous near the base, erect, acute at the apex.

4. West Indies, Cuba, February 14, 1902, Pollard and Palmer, no. 284. Bur small, $5 \pm$ mm. in diameter; outer bristles few, slender, minutely barbed, 4 mm. long, inner bristles connate in the lower portion, acutely pointed at the apex, puberulous.

The Polynesian forms are much alike and differ considerably from specimens collected in Cuba and the Philippines.

II. OPLISMENUS Beauvois

Inflorescence a simple panicle; spikelets reduced to a single bisporangiate terminal floret, the inferior floret vestigial and represented only by an empty rarely staminate palea in the axil of the third glume, which is wrapped around both the fertile floret and the sterile vestigial floret; glumes 4, the first bearing a long awn, the second and third, short awned or merely acute.

Eighteen species, best represented in America; 2 species occur in Africa; 2 in the East Indies; 1 in the Malay region; 3 are pantropic. The 2 species in the Marquesas form a turf and furnish valuable grazing for horses and cattle.

1. *Oplismenus compositus* Beauvois (Pl. V).

Culms weak, decumbent, branching at the base, ascending to a height of 30-40 + cm.; leaves lanceolate, acuminate, 2-6 cm. long, 1 ± cm. wide, auriculate on one side, undulate, scabrous on the margin; ligule ciliate; panicle 7 ± cm. long with 5 ± ascending branches commonly less than 4 cm. long; spikelets 3 mm. high, pilose at the base, subsessile or shortly pedicellate, loosely clustered, chiefly in twos along the panicle branches or near the apex of the culm, 1-flowered; first (lower) glume 2-3 mm. long, 5-veined, with an awn 8 ± mm. long; second glume 2 mm. long, 5-veined, with or without a short awn; third glume 3 mm. long, 7-veined, acute or mucronate, wrapped around the empty palea and vestigial floret and the fertile bisporangiate floret; fourth glume glabrous, shining, indurated, with the edges clasping a palea of similar texture; style divided, the plumose stigmas protruding 2 + mm. above the apex of the spikelet.

A list of reference types follows:

Nukuhiva, Taiohae, altitude 100 meters, June 1, 1921, F. Brown, no. 736; Fatuhiva, Omoa Valley, latitude 200 meters, January 20, 1922, F. Brown, no. 927. Hawaii, Mann and Brigham, no. 328. Rapa, 1921, Quayle, no. X. Mangareva, altitude 200 meters, April 26, 1922 (?), E. H. Quayle, no. 416. Rapa, Ororangi, altitude 100 meters, June 10, 1921, Stokes, no. 29. Rapa, Tuetu, altitude 20 meters, August 25, 1921, Stokes, no. 145. Rapa, Tuele-kula, altitude 200 meters, September 13, 1921, Stokes, no. 185. Rapa, Maitua, altitude 70 meters, October 10, 1921, Stokes, no. 340. Rimatara, Amaru, altitude 20 meters, March, 1921, Stokes, no. 47; Rurutu, Uropepe, altitude 200 meters, February 17, 1921, Stokes, no. 104; Rurutu, altitude 20 meters, March 20, 1921, no. 216.

The description is based on Marquesan specimens, of which there are the two forms described below. Native names are *tepu vaeuhu* in Nukuhiva; *tutaiiaa* in Fatuhiva; *nanamu* and *nganganamu* in Rapa. Natives of the Marquesas make little or no use of the species, but in Rapa it is used as medicine; excellent for grazing, thriving in moist shaded situations.

Pantropic. The following two forms with slight local variation are of probable aboriginal introduction, being similar to forms occurring in Aus-

tralia and Asia as were mentioned by Trimen (44, vol. 5, p. 168) Bentham (4, vol. 8, p. 492). They constitute the chief ground cover under *Hibiscus tiliaceus* and associated trees, which now cover the ancient plantations of the Marquesans in Taipi and other fertile valleys of the Marquesas from altitudes of 200 to 600 meters.

1a. *Oplismenus compositus* Beauvois form *pubescens* (Pl. V, B).

Leaves, sheaths, culms, panicle branches, and 3 outer glumes pubescent.

Nukuhiva, Taipi Vai, August 8, 1921, F. Brown, no. 594, type.

1b. *Oplismenus compositus* Beauvois form *glabratus*, new form.

Same as form *pubescens* but rachis, spikelets, culms and leaves subglabrous.

Marquesas, Fatuhiva, January 20, 1922, F. Brown, no. 927, type. Marquesas, Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 736, reference type.

All plants listed from Rapa, Rurutu, and Mangareva are more or less pubescent; others are subglabrous.

2. *Oplismenus setarius* Roemer and Schultes.

Oplismenus undulatifolius Beauvois.

Distinguished from *Oplismenus compositus* by the reduced panicle branches, the clustered spikelets being sessile or subsessile on the sparingly branched central axis.

Pantropic. The species occurs in the Society Islands, the Philippines, Rapa, Rurutu, Rimatara, and the Galapagos.

2a. *Oplismenus setarius* Roemer and Schultes form *sterilis*, new form.

The following description is based on an obviously sterile grass, no flower or fruit being found, doubtless belonging to this species: Culms weak, prostrate, or inclined, 30 ± cm. high, freely branching, 1 ± meters in length; internodes elongated, glabrous, nodes pilose, soon developing an aerial root; lamina of leaves narrowly lanceolate, rarely over 8 cm. long by 7 mm. wide, acuminate; base acute or narrowly rounded; surface sparingly pilose; margin scabrous; ligule 5 mm. high, pilose; sheaths shorter than the internodes, glabrous on the surface, ciliate on the margin.

Marquesas, Hivaoa, Feani, F. Brown, no. 1034, type. Marquesas, Hivaoa, Atuona, December 8, 1921, F. Brown, no. 841; Nukuhiva, Taipi Vai, August 15, 1921, F. Brown, no. 593; reference types.

The leaf and stem characters compare closely with those of representatives of the species occurring in New Zealand, Australia, and other parts of the western Pacific, and with C. N. Forbes, no. 495 from Kauai, Hawaii.

The ancient Marquesans made no use of this form which is now of importance for grazing. Common in moist, shaded situations in valleys of Hivaoa, and shaded parts of Taipi Vai, Nukuhiva; probably in other

valleys of the Marquesas; fertile form not collected. Both fertile and evidently sterile forms are reported from the Galapagos by Robinson (36, p. 120). Doubtless of unintentional introduction in the Marquesas and other Pacific islands. The native names are *mutie* in Hivaoa, *tapu-vai-heu* in Nukuhiva.

12. ECHINOCHLOA Beauvois

Annual or perennial herbs; inflorescence paniculate with short densely flowered lateral racemes; spikelets crowded, planoconvex, single or clustered on one side of the rachis; first (lower) glume short, acute; second and third glumes subequal acute or terminating in an awn; fourth (fertile) glume planoconvex, smooth, acuminate, the margins rolled inward in the lower portion; palea free in the upper portion.

1. *Echinochloa colonum* (Linnaeus) Link.

Panicum colonum Linnaeus.

Caespitose annual; culms suberect, glabrous, $40 \pm$ cm. in height, bearing $5 \pm$ distant leaves; blades narrowly linear, acuminate, 5-10 cm. in length, $3 \pm$ mm. in width, glabrous, minutely spinulose-serrate on the margin; no ligule; sheaths compressed, glabrous; racemes $5 \pm$ in number, $15 \pm$ mm. in length, forming a simple panicle of $8 \pm$ cm.; flowers crowded on a narrow puberulous rachis $0.3 \pm$ mm. in width; first (lower) glume broadly ovate, apiculate, short, $1 \pm$ mm. long, puberulent on the outer surface, ciliate on the margin, 5-veined; second and third glumes subequal, concave, broadly ovate, acute-apiculate, $2.5 \pm$ mm. in length, pubescent on the outer surface, thin, 3-veined; third (fertile) glume thickened, smooth, ovate, $2 \pm$ mm. long; palea free in the apical portion.

Raivavae, Rairua, altitude 3 meters, April 1, 1921, Stokes, no. 49 and 50, reference type. Native names are *matie* in Raivavae and *seta* in Samoa.

Main distribution in southern Asia, occurring also in tropical America; reported from Tahiti by Setchell (41, p. 149); collected by the writer on Oahu, Hawaii; not collected in the Marquesas.

13. CHAETOCHLOA Scribner (SETARIA Beauvois)

Flowers as in *Panicum*, but the spikelets provided with one or more awn-like bristles near the base. Inflorescence cylindrical and more or less spike-like.

1. *Chaetochloa verticillata* (Linnaeus) Scribner.

Annual; culms erect, $60 \pm$ cm. tall, forming tufts from a decumbent base, glabrous; leaves linear, $15 \pm$ cm. long, $5 \pm$ mm. wide; surface glabrous margin scabrous; ligule ciliate; sheaths glabrous, panicle cylindrical, spikelike, $7 \pm$ cm. long, $15 \pm$ mm. in diameter; spikelets flat on one side, 2 mm. high, clustered $3 \pm$ together on dwarf branches, from which spring stiff, retrorsely barbed bristles 2 to 3 times the length of the spikelets; spikelets deciduous from the bristles when ripe; lower glume $0.7 \pm$ mm. long; second glume convex, 1.3 mm. long; third glume flat, 1.6 mm. long, with only a vestigial palea; fourth glume and palea indurated, 1.6 mm. long, minutely rugose.

Marquesas, Uahuka, November 1, 1921, F. Brown, no. 802. Oeno, April, 1922, E. H. Quayle, no. 405, reference types.

Native name is *pua pipii* in the Marquesas. This name is also given to *Cenchrus*, doubtless because the barbed bristles of this species cling to the clothing like the bur of *Cenchrus*. A pantropic weed of recent introduction, which is frequently found near trading posts.

14. PANICUM Linnaeus

Spikelets pedicellate, paniculate, composed of one bisporangiate flower, with or without a second staminate flower.

The old genus *Panicum* included 457 reported species, with a primary concentration of 251 species in America and a secondary concentration of 135 species in Africa; 25 species occur in Asia, 35 in Australia, 55 in the East Indies, 13 in the West Indies, a few in the Pacific islands; 8 cosmopolitan.

KEY

1. Glume 1 subequal to glume 3 in length.....3. **Panicum ambiguum**
1. Glume 1 shorter than the third (2)
2. Panicle large, 30 ± cm. in length diffusely branched.....1. **Panicum maximum**
2. Panicle rather small, composed of 6 ± simple or sparingly branched racemes commonly less than 3 cm. in length....2. **Panicum prostratum**

1. **Panicum maximum** Jacquin (Pl. V, D).

Perennial; culms 2 ± meters tall, pilose at the nodes, sprouting freely from the base; lamina of leaves 40 ± cm. in length, 1-2 cm. broad, sharply spinulose-serrate on the margin, glabrous except near the base, which is pilose; sheaths pilose at the base and near the ligule, subglabrous in the central portion; ligule long-pilose, the hairs 6 ± mm. long; panicle large, open, 30 ± cm. in length, 20 ± cm. wide, with filiform ascending branches up to 15 + cm. long; spikelets broadly ellipsoidal, truncate at the base, 3 mm. long, on scabrous pedicels, 3-5 + mm. long; lower (basal) glume less than half the length of the spikelet, subacute; second glume obtuse, 3 mm. long; third glume 3 mm. long, the margins clasping a thin palea with a staminate flower; fourth glume 2 mm. in length, transversely rugulose, indurated, clasping a palea of similar texture with bisporangiate flower.

Marquesas, Hivaoa, Atuona, December 18, 1921, F. Brown, no. 873; Nukuhiva, Hakaui, June 7, 1921, F. Brown, no. 656; reference types.

A native of Africa; of recent introduction in the Marquesas. The natives make little use of this grass; economically, however, it is a valuable forage grass, furnishing cut feed for horses and cattle in the Marquesas, where it is cultivated as follows: the grass is planted in hills about 1 meter apart and cultivated at frequent intervals. Numerous sprouts soon spring up from the base, forming a compact clump, which soon grows to a height of 2 ± meters. As required for feed, it is cut close to the base, from which new shoots soon form a second crop. The native names are *mutie* and *kine*; the common English name, guinea grass.

2. *Panicum prostratum* Lamarck, var. *marquisense*, new variety (Pl. V, C).

Gregarious annual, forming a turf; culms slender, decumbent, freely branching, ascending to a height of $30 \pm$ cm.; nodes puberulent; leaves rather numerous, bright green, lanceolate, 2.5 + cm. long, $6 \pm$ mm. wide, cordate; upper surface glabrous, lower surface puberulent; margin spinulose-serrate, long ciliate near the base; ligule ciliate, 1 mm. long; sheaths pilose at the marginal opening, glabrous or subglabrous on the surface; panicles composed of 6 simple or sparingly branched, scabrous, spreading, numerous flowered rays commonly less than 3 cm. long; culm slender, 0.5 mm. in diameter; spikelets commonly in pairs, one subsessile, the other pedicellate, rarely solitary, with 1-3 setose hairs $1-2 \pm$ mm. in length at the base; spikelets flat on one side, broadly ovate, acute, truncate at the base, slightly less than 2 mm. long, purplish to light yellow in color, velvety pubescent, composed of a single fertile flower; first (basal) glume densely pubescent, small, 0.3 mm. in length, obtuse or acute; second glume densely pubescent, convex, 1.8 mm. long, 5-7-veined; third glume pubescent, flat, 5-veined, clasping a 2-veined hyaline palea without a floret; fourth glume glabrous, cuspidate, indurated transversely rugulose, enclosing the bisporangiate flower and palea, of firm texture.

Marquesas, Nukuhiva, western part, Mauu, June 20, 1921, F. Brown, no. 717, type. Marquesas, Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 738, reference type.

Distinguishing characters: culms slender, panicle small, 3 outer glumes pubescent, inferior flower vestigial, under surface of leaves puberulent, nodes puberulent. Seems closely allied to var. *burmanicum* Hooker from Burma, in which the under surface of the leaves and the second and third glumes are puberulent. The characters which distinguish this variety from *burmanicum* seem of minor consequence, not improbably having arisen since the time of ancient introduction by the Polynesians; or the Marquesan variety may still be found in the region of Burma. It is not the same as *Panicum tahitense* Steudel, described by Drake (15, p. 250), who briefly mentions a species (not a variety) with pubescent spikelets. However, his description is too vague for detailed comparison. The native name is *tapu-vae-heuu*.

It is used as a valuable upland pasture grass for horses and cattle; also behaves as a weed in cultivated fields about Taiohae, Nukuhiva.

Pantropic; of probably aboriginal introduction in the Marquesas, where var. *marquisense* is thoroughly established in the vegetation of the arid region of western Nukuhiva up to an altitude of 500 + meters. It thrives under trees and over extensive areas of the submesophytic plateau-like slopes, forming a bright-green turf as a climax to the grass associations.

3. *Panicum ambiguum* Trinius.

Annual; stems slender, weak, $50 \pm$ cm. long, branching at the base, glabrate or puberulous at the nodes; leaves rather distant on the culm; blades linear, flat, $20 \pm$ cm. in length, 5 \pm mm. in width, spinulose-serrate on the margin, pubescent on both surfaces; ligule composed of hairs; sheaths long, glabrate or ciliate on the margins; spikes 3-4, rarely up to 7 in number, 6 \pm cm. in length, attached alternately near the end of the culm;

rachis slender, triangular glabrate to puberulous; pedicels up to 2+ mm. long, puberulous; spikelets racemose along the rachis, subsessile to shortly pedicellate, ovate-acute, compressed, 3-4 mm. in length, with or without a single long hair at the base; glume, 1, ovate, acute 5-veined, $3 \pm$ mm. in length, subequal to glume no. 3; glume no. 2, acute, $3.5 \pm$ mm. long, 7-veined; glume no. 3, ovate, acute, $3 \pm$ mm. in length, obscurely 5-veined, somewhat thickened, tightly clasping the 4th (fertile) glume; glume no. 4, ovate, $2.5 \pm$ mm. in length, thickened, rugose, tightly clasping the palea, terminating in a short awn $0.5 \pm$ mm. in length, which is concealed by glumes nos. 3 and 2.

Rimatara, Amara, altitude 3 meters, March 1921, Stokes, no. 24; altitude 20 meters, March 20, 1921, Stokes, no. 217. Rapa, Teutu, altitude 20 meters, Stokes, no. 156; Rapa, Anarua, altitude 200 meters, September 13, 1921, Stokes, no. 163; Rapa, Tuelekula, altitude 200 meters, September 13, 1921, Stokes, no. 187. Reference types.

Native names are *matie* in Rurutu and *puta maomao* in Rapa. Used as native medicine. Chewed and bound on wounds. An Asiatic-Malaysian grass, probably of early introduction in Rapa and the Austral Islands; not collected in the Marquesas; reported from Samoa by Setchell (40, p. 113).

15. SYNTHERISMA Walter (DIGITARIA Hall)

Annual or perennial herbs; spikes digitate or subdigitate at the end of the culm; spikelets commonly 1-flowered, solitary or clustered, subsessile or on short pedicels, biseriate on the under side of a triangular-flattened rachis; glumes 3-4 in number, the outer minute or absent; the second glume subequal to the spikelet in length; third glume somewhat shorter than the second; fourth glume of firm texture clasping an axillary bisporangiate flower.

A genus of $40 \pm$ species of temperate and tropical regions.

KEY

- | | |
|--------------------------|--------------------------------|
| 1. Spikes erect..... | 2. <i>Syntherisma pelagica</i> |
| 2. Spikes ascending..... | 1. <i>Syntherisma pruriens</i> |

1. *Syntherisma pruriens* (Trinius) Arthur (Pl. VI, B).

Panicum pruriens Trinius.

Panicum sanguinale var. *pruriens*, Drake (15, p. 249).

Annual; culms decumbent at base, 20-100 cm. tall; leaves linear, $5 \pm$ mm. broad, $15 \pm$ cm. long, undulate, scabrous on the margin, pilose on both surfaces; sheaths shorter than the internodes, pilose; ligule hyaline, 2 mm. high; racemes 3 or more, digitate and subterminal, unequal in length, up to 10+ cm. long, ascending; rachis sharply 3-angular, spinulose-serrate on the angles; spikelets laceolate, planoconvex, 3 mm. long, paired, 1 sessile, the other pedicellate; the pedicel $2 \pm$ mm. long, composed of a single bisporangiate floret, rarely monosporangiate; second floret vestigial, without palea, the glume empty, 3 mm. in length, with a single prominent median vein and 2-3 smaller veins near the pilose, incurved margins; glumes of bisporangiate floret $3 \pm$ mm. in length, obscurely veined, incurved and closely clasping the palea; only one basal glume present, the first being absent, small, $1 \pm$ mm. long, obtuse, hairy on the margin.

Marquesas, Nukuhiva, Hakau, low altitude, June 10, 1921, F. Brown, no. 791; Hivaoa, Autona, sea level to an altitude of 800 meters, December 8, 1921, F. Brown, no. 851. Hawaii, Oahu, 1845-1847, Galathea Expedition, Didrichsen, no. 3444. Rapa, 1921, Quayle, no. 338. Mangareva, Mount Duff, altitude 200 meters, April 27, 1921, Quayle, no. 434. Marquesas, Uapou, September 7, 1922, Quayle, no. 1096. Tuamotus, western part, Matahiva, summer of 1923, Quayle, no. 2198. Rurutu, Moerai, altitude $20 \pm$ meters, March 10, 1921, Stokes, no. 219. Rapa, Maria, January 6, 1922, Stokes, no. 447. Reference types.

The native name is *matie* in Rurutu, Austral Islands. A pantropic weed, probably of recent introduction in the Marquesas, where it is frequently found from near sea level to an altitude of $800 +$ meters throughout the islands; occurs also in the Tuamotu Islands, Mangareva, Society Islands, Rapa, Rurutu, Fiji, Samoa, and Hawaii.

2. *Syntherisma pelagica*, new species (Pl. VII).

Perennial with numerous shoots from a short rhizome, caespitose; culms slender or rather stiff, erect ascending, or prostrate at the base, $15-80 +$ cm. in height, branching at the nodes; nodes glabrous; internodes glabrous, numerous, the lower ones $2 \pm$ cm. long, the terminal flower-bearing one up to 20 cm. in length. Leaves numerous, cauline, blades linear-acute, subauriculate, $2-20 +$ cm. long, $2-8 +$ mm. broad, glabrous or somewhat scabrous, smooth or nearly so along the margin, firm to coriaceous in texture; ligule $3 \pm$ mm. in length, thin, truncate, glabrous; sheaths compressed, $3-13 +$ cm. long, glabrous or with a few hairs near the ligule. Spikes $2-10 +$ in number, $4-13 +$ cm. in length, digitate or subdigitate at the end of the culm, erect, closely appressed; rachis broad, $2 \pm$ mm. in width, flat or concave on the back, the sides winglike, projecting beyond the closely appressed spikelets, glabrous, the keel prominent, sinuous, $0.5 \pm$ mm. in height; spikelets sessile or on short, stiff pedicels of $0.2 \pm$ mm. in length, in 2 rows, 1 on each side of the keel, ovate, acute, $2-4$ mm. long, planoconvex; first glume minute, triangular, $0.5 \pm$ mm. in length, puberulent as a rule; second glume ovate, acute, $2-4$ mm., as long as the spikelet, bicarinate, flat on the dorsal surface, 5-veined, not commonly 3-veined, prominently bicarinate, with the sides incurved tightly clasping the edges of the third glume, coriaceous and stiff except the hyaline margins, pubescent, puberulous, or glabrate, with the keels puberulent, especially near the apex; third glume subequal to the second or slightly longer, 3-veined, of firm texture, smooth, glabrous, the sides incurved, tightly clasping the fourth glume; fourth glume (palea) slightly shorter than the third, smooth, of firm texture, 2-veined, the sides incurved around the flower; 3 stamens; filaments $3 \pm$ mm.; anthers sagittate, $2 \pm$ mm.; styles 2, slender, $2 \pm$ mm. in length, distinct to near the base; stigmas plumose, $2 \pm$ mm. in length, yellowish-white, protruding from the apex of the spikelet; caryopsis elliptical in outline, $1.5 \pm$ mm. long, compressed, yellowish-white.

Evidently closely allied to *Panicum* (*Syntherisma*) *stenotaphroides* Nees, but cannot be accurately compared in the absence of sufficient description available. According to a description given by Steudel (43, p. 41), *Syntherisma pelagica* differs from *S. stenotaphroides* in the presence of a more or less puberulent surface of the second glume, and in the larger number of spikes, which range from $2-13 +$ in *Syntherisma pelagica* and $3-4$ in *Syn-*

therisma stenotaphroides. Several varieties are known. The native name is *mauku* in Fangatau, Tuamotus.

KEY

1. Spikelets 2.5-3 mm. in length, distant or overlapping; third glume longer than the rest, distinctly protruding from the apex of the spikelet; blades $12 \pm$ mm. in length, $7 \pm$ mm. in width; spikelets $9 \pm$ in number, $6 \pm$ cm. in length..... (2)
1. Spikelets 3-4 mm. in length, distant or overlapping; third glume approximately as long as the second, not distinctly protruding; spikes $5 \pm$ in number, 4-13+ cm. in length—Tuamotuan types..... (3)
2. Spikelets overlapping 1. var. α
2. Spikelets distant 2. var. β
3. Spikelets $4 \pm$ mm. in length..... 3. var. γ
3. Spikelets less than 4 mm. in length (4)
4. Spikelets $3.5 \pm$ mm. in length (5)
4. Spikelets $3 \pm$ mm. in length..... 7. var. ζ
5. Spikes 7 cm. in length or longer..... 4. var. δ
5. Spikes less than 7 cm. in length (6)
6. Second glume plainly 3-veined or obscurely 5-veined..... 5. var. ϵ
6. Second glume plainly 5-veined..... 6. var. η

1. ***Syntherisma pelagica* F. Brown var. α , new variety.**

Spikelets 2.5-3 mm. in length, overlapping; second glume distinctly puberulous under a lens, distinctly 5-veined, 0.2-0.5+ mm. shorter than the third; culms stout, 1.5-2+ mm. in diameter, 15-70+ cm. in length; blades $12 \pm$ cm. in length, 5-8+ mm. in width.

Malden Island, November 22, 1924, Gerrit P. Wilder, no. 1, type. Baker Island, September 23, 1924, Erling Christophersen, no. 38, reference type (See Christophersen, E., Vegetation of Pacific equatorial islands: B. P. Bishop Mus., Bull. 44, p. 70, 1927).

2. ***Syntherisma pelagica* F. Brown var. β , new variety.**

Similar to variety α , but the spikelets distant; outer glume plainly 3-veined or obscurely 5-veined.

Christmas Island, August 1, 1924, H. P. Bergman, no. 7, type. (See Christophersen, E., Vegetation of Pacific equatorial islands: B. P. Bishop Mus., Bull. 44, p. 22, 1927.)

3. ***Syntherisma pelagica* F. Brown var. γ , new variety (Pl. VII, f).**

Spikelets $4 \pm$ mm. in length, distant or somewhat overlapping; second glume subequal to the third in length, $1.2 \pm$ mm. in width, distinctly 5-veined, puberulent on the back or glabrate in the center; culms rather stout, $1.5 \pm$ mm. in diameter, 40-70+ cm. in length; $6 \pm$ spikes, $8 \pm$ cm. in length; blades $12 \pm$ cm. in length, $5 \pm$ mm. in width.

Tuamotus, Arutua, February 2, 1923, R. H. Beck, no. 1876, type (spikelets overlapping). Tuamotus, Fakarava, April 20, 1923, E. H. Quayle, no. 2023, reference type (spikelets distant, as a rule). Area of distribution includes Arutua and Fakarava, northern Tuamotus.

4. *Syntherisma pelagica* F. Brown var. δ , new variety.

Spikelets $3.5 \pm$ mm. in length, distant or somewhat overlapping; second glume 3-5-veined, sub-equal to the third in length, pubescent on the back; spikes $6 \pm$ in number, $10 \pm$ cm. in length; culms $1-1.5 \pm$ mm. in diameter; blades $15 \pm$ cm. in length, $5 \pm$ mm. in width.

Tuamotus, Manihi, February 10, 1923, Quayle, no. 1918, type (second glume plainly 3-veined or obscurely 5-veined). Tuamotus, Takapoto, August 29, 1922, Jones, no. 1010; Kauehi, March 9, 1923, Quayle, no. 1972; Katiu, May 17, 1923, Quayle, no. 2116; Makemo, Quayle, no. 2103; Rangiroa, summer of 1923, Quayle, no. 2187; Raraka, March 14, 1923, Quayle, nos. 1962 and 1996; Tenararo, Quayle, no. X (spikes 11 cm. in length); Takume, May 10, 1923, Quayle, no. 2067 (spikes 13 cm. in length); reference types.

Area of distribution comprises Takapoto, Kauehi, Katiu, Makemo, Rangiroa, and Raraka, of the northern Tuamotus, also Takume and Tenararo of the southern Tuamotus.

5. *Syntherisma pelagica* F. Brown var. ϵ , new variety.

Spikelets $3.5 \pm$ mm. in length, very distant; second glume subequal to the third, plainly 3-veined or obscurely 5-veined, pubescent on the back; spikes 2-3 + in number, $4 \pm$ cm. in length; rachis $2.5 \pm$ mm. in width; culm $1 \pm$ mm. in diameter; blades $5 \pm$ cm. in length, $2 \pm$ mm. in width.

Tuamotus, southern part, Parao, June 27, 1922, E. H. Quayle, no. 979, type.

7. *Syntherisma pelagica* F. Brown var. ζ , new variety.

Spikelets $3 \pm$ mm. in length, distant; second glume 5-veined, subequal to the third in length; blades $8 \pm$ cm. in length, $4 \pm$ mm. in width; culm $1 \pm$ mm. in diameter; spikes $4 \pm$ in number, $6 \pm$ cm. in length; rachis $3 \pm$ mm. in width.

Tuamotus, Nengonengo, June 29, 1922, E. H. Quayle, no. 588, type. Tuamotus, Tureia, June 19, 1922, E. H. Quayle, no. 519, reference type. Area of distribution includes Nengonengo and Tureia, southern Tuamotus.

6. *Syntherisma pelagica* F. Brown var. η , new variety.

Spikelets $3.5 \pm$ mm. in length, distant or touching; second glume 5-veined, subequal to the third, pubescent; culm $1 \pm$ mm. in diameter; spikes $6 \pm$ in number, $5 \pm$ mm. in length; blades $10 \pm$ cm. in length, $4 \pm$ mm. in width.

Tuamotus, Fungatau (Augatau), April 10, 1921, F. Brown, no. 322, type. Tuamotus, Faaite, April 26, 1923, E. H. Quayle, no. 2035, reference type. Area of distribution includes Fangatau and Faaite, northern Tuamotus.

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16. PASPALUM Linnaeus

Spikelets with a single bisporangiate floret, planoconvex, racemose on one side of the simple branches of the panicle, sessile or shortly pedicellate; 2 outer glumes thin, empty; flowering glume convex, indurated, clasping a palea of similar texture.

About 160 species, having a primary concentration in tropical America, a few in Africa and Asia, and several widely distributed in the Pacific islands.

KEY

- | | |
|---|--------------------------------|
| 1. Racemes commonly 2 in number, subterminal (2). | |
| 1. Racemes several (3). | |
| 2. Racemes 4± cm. in length..... | 1. Paspalum distichum |
| 2. Racemes 10+ cm. in length..... | 3. Paspalum conjugatum |
| 3. Racemes 3-6+ in number..... | 4. Paspalum orbiculare |
| 3. Racemes 10-25+ in number..... | 2. Paspalum paniculatum |

1. **Paspalum distichum** Linnaeus (Pl. VI, C).

Perennial; culms 20-65 cm. tall, erect from a decumbent creeping base, rarely flowering; leaves convolute, 10± cm. long, glabrous; spikes 2, rarely 3, 4± cm. long, borne near the end of the enclosed culm; spikelets broadly lanceolate, 4 mm. in length, glabrous in the Marquesan specimens.

Marquesas, Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 734. Philippines, Los Banos, June to July 1917, A. D. E. Elmer, no. 18140. Marquesas, Uahuka, Père Simeon Delmas, no. X. Mangareva, E. H. Quayle, no. X. Tuamotus, Niau, near sea level to altitude of 4 meters, August 16, 1922, W. B. Jones, nos. 831 and 835. Rapa, Moerai, seashore, January 14, 1921, Stokes, no. 43. Reference types.

A pantropic shore plant, common throughout the trading ports of the Marquesas, where it is gregarious on the sandy beaches; one of the foremost plants of the shore line, where it is flooded or sprayed at frequent intervals by sea water; not found in the interior. Probably of early unintentional introduction. Also occurs in Hawaii, Samoa, Rurutu, Mangareva, and the Tuamotus. Native names are *mutie* in the Marquesas, *matie taravaro* in Rurutu.

2. **Paspalum paniculatum** Linnaeus (Pl. VI, D).

Perennial, 1± meters high, pilose throughout, with long hairs at the nodes; leaves flat, 4-10 cm. long, 1.5-2 cm. broad, spinulose-serrate on the margin, pilose near the ligule; inflorescence broadly conical; spikes numerous, 25± in number, 1-7+ cm. long, ascending, curved; rachis 0.5± mm. wide; spikelets crowded on one side of a rachis, small, hemispherical, 1.3± mm. in diameter, commonly in twos on unequal pedicels 0.5-1+ mm. long, puberulent; outer glumes 2, membranous, pubescent, with prominent midveins, the first convex, clasping the edges of the second, which is flat; flowering glume hemispherical, sclerous, clasping the edges of a sclerous palea; flower bisporangiate; 3 stamens; 2 short purple stigmas.

Marquesas, Nukuhiva, June 7, 1921, F. Brown, no. 667, reference type.

A native of tropical America and the West Indies; probably of early introduction in the Marquesas, throughout which it is common and gregarious, from near sea level to an altitude of 900 + meters; also found in Samoa. Native names are *kohe kira* (foreign grass) in the Marquesas, *ofe ofe* in Tahiti.

3. *Paspalum conjugatum* Berger.

Perennial; culms erect, 1 meter in height, racemes commonly 2, conjugate, 10 cm. long.

Marquesas, Nukuhiva, Tovii, altitude 900 meters, September 23, 1921, F. Brown, no. 750. Austral Islands, Raivavae, altitude 80 meters, April 19, 1922, Stokes, no. 82; Rurutu, March 15, 1921, Stokes, no. 200. Reference types.

Native names are *matie* in Nukuhiva, *piohe* in Fatuhiva, Marquesas Islands; known as "Hilo grass" in Hawaii. No uses are made of this species; cattle and horses refuse to eat it; a troublesome weed.

Pantropic, probably of rather late introduction in the Marquesas, where it is common and gregarious, from sea level to the highest altitudes, invading and crowding out other vegetation, as in Hawaii.

4. *Paspalum orbiculare* Forster.

Perennial; culms 30-80 + cm. in height, glabrous, bearing several distant leaves; blades linear-acuminate, 10-30 + cm. in length, 8 ± mm. in width, glabrous, minutely spinulose on the margin; ligule membranous, 1 ± mm. in length; sheaths compressed; racemes alternate, distant, 3-6 in number, 2-4 + cm. in length, shortly stalked, with several long hairs at the base; spikelets ovate-orbicular, 2 ± mm. long, glabrous, closely biserrate along a flat rachis 1.5 ± mm. in width; the 2 outer glumes subequal, of the same shape and size as the spikelet, glabrous, thin 1-veined in the center, with a marginal vein on each side; fertile glume and palea indurated, smooth, yellowish-brown.

Pitcairn Island, 1921, E. H. Quayle, no. X. Austral Island, Rimatara, altitude 15 meters, March, 1921, Stokes, no. 20. Reference types.

The native names are *noanoa* in Rurutu; *nonoha* in Tahiti; *ehere, taru*, and *taru moano'a* in Rapa, and *aretu* in Tubuai, Austral Islands. In Rapa it is used as house thatch, floor covering, and medicine; in Tubuai as floor covering. The area of distribution includes Asia, Australia, Malaysia, and Polynesia.

17. THUAREA Persoon (ORNITHOCEPHALOCHLOA Kurz)

Perennial herb with long prostrate stems; spike terminal, included in the spathe-like sheath of the upper, reduced leaf; spikelets monosporangiate,

uniserial upon the trough-shaped rachis, 2-flowered, the flowers monoecious; the upper 4-6 flowers staminate, the lower 1-2 flowers bisporangiate or carpellate; glumes 3-4 in number, the first minute or absent; the second empty, as long as the spikelet or somewhat shorter; third and fourth glumes fertile, subequal; 3 stamens; 2 styles; stigmas plumose; caryopsis free within the palea and glume. Monotypic; Asia, Malaysia.

1. *Thuarea sarmentosa* Parsoon.

Thuarea involuta R. Brown.

Stems slender, glabrous as a rule, prostrate, 20-100+ cm. long; leaves numerous, distant, in 2 ranks along the stem; blades linear-lanceolate, 3-6+ cm. in length, 5 ± mm. in width, glabrous, rather thick and firm in texture, yellowish-brown when dry, the surface puberulent to glabrate; ligule short, thin, ciliate; sheaths shorter than the blades, glabrous or puberulent; nodes glabrous or puberulous, spike terminal, 1-sided, 2 ± cm. long, partly enclosed in a spathe-like sheath; rachis trough-shaped, puberulent; spikelets sessile, 3-4+ mm. in length; outer glume broadly ovate, 4 ± mm. long, 5-veined, puberulent; interior glumes of nearly the same length, ciliate near the apex.

Austral Islands, Rurutu, June 12, 1921, Stokes, no. 3. Tonga, 1920, Giffard and McKern, no. 57. Philippines, Mindanao, October, 1909, A. D. E. Elmer, no. 11920. Tuamotus, Vana Vana, June 22, 1922, Quayle, no. 540; Society Islands, Scilly, January 3, 1922, Quayle, no. 236. Austral Islands, Raivavae, Quayle, no. 274. Henderson Island, Quayle, no. 397. Reference types.

Native names are *matie* and *auneune* in Rurutu, Austral Islands; *eiteari* in Mangaia, Cook Islands.

TRIBE 5. AGROSTIDEAE

Spikelets 1-flowered, stipitate and jointed above the 2 lower glumes, which remain attached to the branches of the panicle after the fall of the seed; rachilla terminating with or extending beyond the base of the flower.

18. ARISTIDA Linnaeus

Leaves commonly narrow and convolute; inflorescence paniculate or subracemose; spikelets 1-flowered pedicellate, the pedicel jointed above the insertion of the 2 lower glumes, not produced at the end; 3 glumes, the 2 lower ones persistent; third glume enclosing a bisporangiate flower and a 2-veined palea, terminating in a 3-parted awn; 3 lodicules; 3 stamens.

Approximately 280 species, of which 130 occur in tropical America, 90

in Africa, 24 in Asia, 4 in the Galapagos, 4 in Madagascar, and 7 in the Philippines.

1. *Aristida subspicata* Trinius and Ruprecht (Pl. VI, A).

Perennial, forming low tussocks $30 \pm$ cm. in height; lamina of leaves 5-15 cm. long, $1 \pm$ mm. broad when unrolled, commonly convolute filiform, pubescent on the dorsal surface; ligule pilose; sheaths glabrous, shorter than the internodes; panicle very narrow, subspicate, $9 \pm$ cm. long, $5 \pm$ mm. wide, light-yellow, 2 lower glumes empty, cuspidate, somewhat unequal, $7 \pm$ mm. long; flowering glume closely wrapped around the seed, terminating in a 3-parted awn $10 \pm$ mm. in length, the whole deciduous from the lower glumes which persist on the panicle branches.

Marquesas, western Nukuhiva, Mauu, June 20, 1921, F. Brown, no. 435, reference type.

The presence of this and other American plants cited in order of treatment in the text suggest early contact of the Marquesans with the American continent. It should be observed that the Marquesan plants differ in a few minor characters from those collected in the Galapagos (Stewart, nos. 1206, 1208, and 1209, Albemarle Island). In the Marquesan specimens, the basal glumes are 5.8 mm. long; apical cusp 5 mm. in length; leaves tightly rolled; branches of the awn $10 \pm$ mm. long. In specimens from the Galapagos the basal glume is $6.5 \pm$ mm. in length; cusp, $1 \pm$ mm. in length; branches of awn 15 mm. in length; leaves convolute or flat; panicle narrow, spikelike.

This grass serves as an excellent ground cover for dry, moderate slopes of volcanic soil, exposed to strong insolation and heavy winds; but the tissues are too woody in texture to be of any value as forage or pasture. Native name is *pavaohina* in the Marquesas, from the resemblance of the mature plant to the *pavahina*, an upright plume in the native head dress, made from the yellowish-white beard of old men; not infrequently the natives of Nukuhiva wore a yellowish-white tuft of this grass in place of the *pavahina*.

Native of South America: also occurs in the Galapagos; collected in the Marquesas only from western Nukuhiva, where it forms the chief ground cover in the extensive and picturesque low-tussock prairie. The presence of this American grass as a dominant element in the prairie of Nukuhiva is of interest. It is not unlikely that it was unintentionally brought in by the early inhabitants, possibly at the same time that the wild pineapple was introduced.

19. AGROSTIS Linnaeus

Annuals or perennials; inflorescence paniculate or subspicate; spikelets numerous, 1-flowered, rachilla jointed above the 2 lower glumes, not produced beyond the base of the flower; glumes 3, the 2 lower ones empty, subequal, 1-3-veined, with or without a dorsal awn; stamens 1-3; styles, 2, short;

stigmas plumose; caryopsis elongated, free, within the incurved sides of the third glume.

A distinctly American genus of remarkably wide distribution, extending to the limit of vegetation in Arctic and Antarctic regions and to high altitudes in the Tropics. Over 300 species have been reported, of which more than one-half are credited to North and South America, where they center in the southern Andes; few species in Europe, Asia, East Indies, Philippines, or Africa; 8 species in New Zealand; 4 species in Australia; 1 or more species in Kerguelen Island, Auckland Island, Campbell Islands, Marquarie Island, Fuegia, Faulkland, Greenland, Canary Islands, St. Helena, Azores, West Indies, Easter Island, Juan Fernandez, Hawaii, Fiji; not collected in the Marquesas, Tuamotus, Society Islands or Cook Islands.

1. *Agrostis rapensis*, new species (Pl. VIII).

Culm slender, 20-26 + cm. in length, erect from a decumbent caespitose base, glabrous; leaves numerous at the base of the culm, few and relatively short in the upper portion of the culm; blades narrowly linear, flat or involute, 3-45 ± cm. in length, the uppermost shorter or somewhat longer than the inflorescence, 1-4 ± mm. in width, scabrous along the margin and along the surface of the numerous prominent veins; ligule truncate, lacerate, membranous, 1 ± mm. in length; sheaths long, 9-15 + cm. in length, glabrous or scabrous, the veins prominent; panicle contracted, spikelike, 6-12 + cm. long, 2 ± cm. in diameter including the numerous ascending or spreading capillary awns; rachis scabrous; branches short, slender, suberect, scabrous, slightly thickened below the glumes; outer glumes 2, narrow, boat-shaped, subequal, 5-6 mm. in length, 1-veined, the heel prominent, spinulose-serrate; rachilla short, articulate above the persistent basal glumes, pilose with numerous short hairs above the articulation and below the base of the flower; flowering glume 4.5 ± mm. in length, attenuate to a slender apex, which under high magnification is bifurcate with a denticulate margin, rather thin, obscurely 5-veined, the outer surface minutely scabrous and bearing a long, straight or curved antrorsely barbed awn 25 ± mm. in length from near the middle; palea narrowly lanceolate, 3 ± mm. long, hyaline, 1-veined, minutely denticulate along the margin and the subacute apex; stamens 1-3; filaments slender, 2 ± mm. in length, joined to the base (not back) of the anther; anther short, 1.2 ± mm. long, broad, slightly notched at the base, 2-lobed at the apex, dehiscent at the side or upper lateral edge; pollen grains sub-circular, 28 ± μ in diameter, bearing 3 low protrusions; stigmas 2, sessile, 1.5 ± mm. long, plumose, hyaline, the branches commonly forked, 0.3 ± mm. in length; caryopsis narrowly ellipsoidal, 2 ± mm. long, shortly beaked at the end.

Rapa, Maitua, altitude 100 meters, October 10, 1921, Stokes, no. 342 (2 sheets), type. Rapa, Teumukopukuke, altitude 180 meters, October 13, 1921, Stokes no. 309; Rapa, Morongota, altitude 270 meters, July 20, 1921, Stokes, no. 113; reference types.

Evidently more than one form of this species in Rapa, as specimens collected from different localities differ slightly in minor characters. For example, Stokes no. 309 differs from the type in the form and size of the leaf blades, which are flat, relatively broad, the uppermost blade subequal to the panicle in length. Stokes no. 113 is characterized by its tightly involute blades, which are subfiliform in shape. The species is very closely allied to

the Andean Antarctic *Agrostis magellanica* Lamarck, to which *Agrostis antarctica* and *Agrostis multicaulis* have been reduced by Hooker. *Agrostis rapensis* differs from Hooker's description and illustration (23, vol. 2, p. 374, pl. 132) in the more contracted panicle, the truncate ligule, the subacute flower glume, long awn, and relatively long palea. Of probable American origin by way of Antarctica.

The native names are *eihere papaa* and *taru* in Rapa. Endemic in Rapa, where it is used for house thatch and floor covering.

TRIBE 6. FESTUCEAE

Inflorescence paniculate, racemose or spicate; spikelets 1- to several-flowered, the flowers commonly bisporangiate; glumes with or without awns, the 2 basal ones empty, commonly unequal and shorter than the nearest floral glume; palea 2-veined; 1-3 stamens; stigmas plumose, protruding from the sides of the spikelet.

20. ERAGROSTIS Beauvois

Spikelets composed of 2 or more bisporangiate flowers, with 2 empty 1-veined, commonly awnless glumes at the base. The floral glumes are 3-veined and without awns, as a rule; in many species the palea persists after the fall of the seed and glumes.

Approximately 360 species centering in Africa and tropical America (130 species each), 30 species in Asia, 30 in Australia, 10 in Europe, 6 in Malaysia, 1 in the Galapagos, 2 in the Marquesas, 2 in the Society Islands, 8 in Hawaii.

The mountain flora of the Marquesas is characterized by endemic species of *Eragrostis*. The whiplike leaves of *E. xerophila*, which are similar in form to those of the associated *Pennisetum articulare*, are remarkably resistant both to the drying influence of the sun and the mechanical effects of the constant winds. Both species predominate on the face of the coastal cliffs.

1. *Eragrostis marquisensis*, new species (Pl. IX, B).

Perennial, 20-40 + cm. high; culms erect, with the leaf-bearing nodes crowded at the erect, inclined, or prostrate woody base; leaves numerous, longer than (Brown no. 1019) or shorter than (Brown, no. 969) the panicle, convolute toward the apex into a long filiform tip, but commonly flat in the lower and central portions, 10-40 + cm. long, 7 ± mm. wide, reddish-green, glabrous on the ventral surface, scabrous on the dorsal surface, smooth or minutely spinulose-denticulate on the margin; sheaths glabrous, crowded at the base, and equitant; ligule hyaline, membranous, narrow, 0.5 ± mm. high, glabrous; panicle conical, 7-10 + cm. long, 2-7 + cm. broad, with ascending scarcely branched rays 2-3 + cm. long; the central axis and branches scabrous, puberulous; spikelets 4 mm. long on pedicels of 1-2 + mm. composed of 2-4 flowers, racemose along

the commonly unbranched rays of the panicle; 2 basal glumes empty, 1-veined, short-awned, scabrous on the keel, subequal to the floral glumes in length (no. 1019) or the lower one about one-third shorter (no. 969); floral glumes 3 mm. long, acuminate, terminating in a short awn, 3-veined, the marginal vein ciliate, the median vein spinulose-serrate and minutely ciliate; palea with 2 submarginal veins, ciliate, deciduous with the glumes; style branches short, $1 \pm$ mm. long, broadly plumose, deep-purple.

Marquesas, Fatuhiva, January, 1922, F. Brown, no. 969, type. Hivaoa, Feani Trail, December, 1922, F. Brown, no. 1019, reference type.

The specimens from Hivaoa (Brown, 1019) differ from those of Fatuhiva (Brown, no. 969) in being taller and in having 3 functional flowers in the spikelet, the fourth being rudimentary and terminating the extended rachis; also, the 2 basal glumes in some of the spikelets are nearly equal in length. The species is closely allied to the Hawaiian *E. variabilis*, from which it is distinguished by the more crowded condition of the nodes at the base, the awntipped glumes, and the deciduous palea.

Though of no particular use, this grass is desirable for ground cover, affording shelter to birds.

Endemic in the Marquesas, where it occurs frequently throughout the islands at high altitudes, 800 + meters.

2. *Eragrostis xerophila*, new species (Pl. IX, A).

Perennial, growing in low tussocks $60 \pm$ cm. high; culms inclined from small, wiry, woody, intricately branching nodose stems at the base; lamina of leaves whiplike, tightly convolute, and filiform, $40 \pm$ cm. long, 0.5-1.0 mm. basal diameter, or 2-4 mm. when unrolled, gradually tapering into a slender filiform apex 0.1 mm. in diameter; outer (ventral) surface at first scabrous but soon wearing smooth; margins minutely spinulose-serrate; interior (dorsal) surface scabrous; veins numerous, highly sclerous; ligule very long (3-7 mm.), hyaline fimbriate and commonly 2-cleft, with long silky hairs at the base; sheaths elongated and continuous with the lamina, closely crowded, overlapping, attached to the woody base of the stems, commonly glabrous except near the ligule; panicle ample, $25 \pm$ cm. long, lax, the rays sparingly branched, ascending, $6 \pm$ cm. long, greenish-yellow, scabrous; spikelets racemose, on pedicels $1 \pm$ mm. in length, 2-3 flowered; 2 basal glumes acute, 1-veined, subequal to the floral glumes, or the lower somewhat shorter, serrulate on the keel, in many specimens persistent after the fall of the floral glume and palea; floral glumes 2.5 mm. long, 3-veined, ciliate along the 2 marginal veins, the median vein spinulose-serrate, terminating in an acute or mucronate tip less than 0.5 mm. in length; palea short, minutely ciliate on the 2 veins, deciduous with the floral glumes; flowers bisporangiate, occasionally monosporangiate (either staminate or carpellate) or the terminal floret sterile; style branches 2 in number, plumose, white or brownish; 3 stamens.

Marquesas, western Nukuhiva, Mauu, altitude $400 \pm$ meters, June 20, 1921, F. Brown, no. 436, type. Marquesas, western Nukuhiva, June 20, 1921, F. Brown, no. 701, reference type.

Eragrostis xerophila and *E. marquisensis* are closely allied and probably descended from a single ancestral immigrant. As in *Pennisetum*, evolutionary tendencies are expressed chiefly in the xerophilous structure of the leaf.

Eragrostis xerophila is far more abundant and more highly specialized than the relatively primitive *E. marquisensis*. Although the 2 species are remarkably distinct in growth form and habit, the flower and spikelet are similar, the 3 flowers in the spikelet of *E. marquisensis* being reduced to 2 somewhat smaller flowers in *E. xerophila* (Pl. IX, A).

The leaves were used by the ancient Marquesans for filling their beds, for which purpose they are excellent. This grass is of no use as forage or pasture, but makes good ground cover for exposed rocky situations, where the tussocks offer excellent nesting places for a large number of sea birds. From isolated island-cliffs, such as East Sentinel Rock at the entrance to Taiohae Bay, Nukuhiva, enormous quantities of these birds' eggs, almost as large as hens' eggs, are gathered frequently by the natives and served as food. A bushel of eggs can be picked up in about 30 minutes by one person. The native name is *peheututue* or *pehututue*.

3. *Eragrostis amabilis* (Linnaeus) Wight and Arnott.

Poa amabilis Linnaeus,

Eragrostis plumosa Link.

Annual, 30 ± cm. tall; culms slender, glabrous, decumbent at the base; leaves 6 ± cm. long, 4 ± mm. wide, glabrous; veins numerous, prominent; sheaths long-ciliate in the upper portion, nearly glabrous below; panicles conical, plumose, 13 by 5 ± cm. long, purplish-yellow to light-green, long exserted at maturity; branches filiform, spreading, with long hairs at the nodes; pedicels commonly as long as the spikelets or longer, spikelets 4-6-flowered; glumes 1 mm. in length; palea bordered with long hairs.

Tuamotus, Fangatau, April 10, 1921, F. Brown, no. 324. Marquesas, Nukuhiva, Taipi Vai, low altitude, F. Brown, no. 591; Fatuhiva, Omoa Valley, January, 1922, F. Brown, no. 1000. Tuamotus, Niau, August 16, 1922, Jones, no. 830; Rangiroa, August 22, 1922, Jones, no. 937. Marquesas, Nukuhiva, Taiohae, 1921, Père Simeon Delmas, no. 30. Mangareva, Tairaiwai, May 10, 1922, Quayle, no. 479. Tuamotus, southeastern part, Tureia, June 19, 1922, Quayle, no. 529; Manihi, February 10, 1923, Quayle, no. 1907; Austral Islands, Rimatara, Amaru, March, 1921, Stokes, no. 34. Reference types.

A native of Asia, it is probably of recent introduction in the Marquesas, where it occurs frequently in waste places near trading ports; also occurs in Mangareva, the Tuamotus, Austral Islands, Samoa, and Hawaii.

Native names are *tutae puriki* in the Marquesas; *nonamu* in Niau and Fangatau, Tuamotus; and *fali funa fua laetitii* in Samoa.

4. *Eragrostis pilosa* Beauvois.

Credited to the Marquesas by Drake (15, p. 262), not collected by anyone during recent surveys; *E. amabilis* was mistaken for this species by Drake, as his description shows: "Gaine des feuilles garnie extericurement et au sommet de longs poils épars"

Panicle lâche, à branches grêles, munies à leur aisselle de glandes longuement ciliées . . . ; épillets longs de 1 mm."

21. CENTOTHECA Desvaux

Centotheca latifolia (Linnaeus) Trinius (Pl. IX, C).

Centotheca lappacea Desvaux.

Culms erect, 80 ± cm. high; roots numerous, rather fine; leaves lanceolate, acuminate, 14 ± cm. long, 24 ± mm. wide with either a few scattered hairs on both upper and lower surfaces, or glabrous and punctate with the persistent bases of deciduous hairs; primary veins 13 ±, between which are many finer veins connected by numerous transverse reticulate branches; sheaths pilose near the ligule; ligule membranous, 1 ± mm. wide; panicle 18 ± cm. long, the spreading or ascending branches puberulent; spikelets 5 ± mm. long, on pedicels of nearly the same length, 2 flowers functional, the third rudimentary at the end of the extended rachilla; 2 lower glumes empty; both flowers sessile and perfect, or rarely the lower staminate; lower glumes 4 mm. long, glabrous; upper flower 3 mm. in length, with long reflexed hairs along the upper portion near the margin; stamens small, 2-3.

Marquesas, Hivaoa, Atuona, December 8, 1921, F. Brown, no. 855; Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 758; Nukuhiva, low altitude, June 12, 1921, F. Brown, no. 449; Hivaoa, Atuona, altitude 600 meters, F. Brown, no. 1087. Austral Islands, Tubuai, altitude 50 meters, April, 1922, R. T. Aitken, no. 903. Marquesas, Uapou, September 7, 1922, W. B. Jones, no. 1095; Nukuhiva, Taiohae, Simeon Delmas, no. 37. Society Islands, Tahiti, Fautau, July 28, 1922, Quayle, no. X; Tahiti, Mount Aorai, altitude 600 meters, October 5, 1921, Quayle, no. 108. Samoa, Pago Pago, June to July, 1922, W. A. Setchell, no. 78. Austral Islands, Rimatara, altitude 25 meters, March, 1921, Stokes, no. 18, reference types.

This grass is adapted for dispersal by human agency in much the same way as *Rhapis aciculata*, which is also called *kohe kohe*. The mature spikelets cling to tapa by means of the sharp bristles of the upper flower. Both grasses are of Asiatic origin and similarly distributed over the Pacific islands, except that *Centotheca* is unrecorded from Hawaii. Pantropic and widely distributed in the Pacific islands.

The native names are *kohe kohe*, *ko'e ko'e*, *autenia*, *tapu-vae-heuu* in the Marquesas; *ohe ohe* in Tahiti; *ofe ofe* and *sefa* in Samoa.

22. BRIZA Linnaeus

Annual or perennial grasses; panicles spreading or contracted; spikelets several-flowered, the rachilla jointed below the flowering glumes; glumes concave, crowded, 2-ranked, persistent, the 2 basal ones empty; palea relatively small, 2-veined; 3 stamens; 2 styles; stigmas plumose; caryopsis ovate.

A genus of wide distribution, composed of few species.

1. *Briza minor* Linnaeus.

Annual; stem leafy, erect from a branched base, 20-40 + cm. in height, smooth; leaf blades flat, 3-20 + cm. in length, 5 ± mm. in width, glabrous on the surface, minutely scabrid on the margin; ligule elongated, ovate, acute, thin, 6 ± mm. in length, with long, decurrent sides extending for a distance of 30 ± mm. on the inside of the sheath; sheaths long, glabrous, not distinctly separated from the blade; panicle 8-15 + cm. long, 2-5 + cm. broad, diffusely branched, the primary branches ascending or suberect; spikelets terminating the ultimate branches, on slender scabrid pedicels 6-10 mm. long, compressed, broadly ovate in outline, subcordate at the base, 3-6 mm. in length, 4 ± mm. in width, 5-7 + flowered; glumes 2-ranked, closely imbricate, deeply concave, cordate at the base, hyaline at the edge, the lower 2 empty, 3 ± mm. long, the upper glumes flower-bearing, shorter, 2 ± mm. in length and nearly as deep; palea broadly elliptical, acute, hyaline, 1.5 ± mm. long.

Rapa, Hiri, altitude 160 ± meters, September 23, 1921, Stokes, no. 22; Rapa, Maitua, altitude 41 ± meters, October 10, 1921, Stokes, no. 316; reference types.

An Old World weed, probably of relatively recent introduction in Rapa. Not collected in the Society Islands, Tuamotus, or the Marquesas; occurs as a weed in Hawaii. It has no native name; the common English name is quaking grass.

TRIBE 7. CHLORIDEAE

Spikelets compressed, 1- to several-flowered, the upper flowers more or less reduced and vestigial; spikes digitate in the Marquesan representatives; all are exotic.

23. *ELEUSINE* Gaertner

Spikelets several-flowered, imbricate on 1 side of a rachis, which is not prolonged beyond the spikelets.

About 30 species. Half of these occur in Africa, 5 in America, 4 in Asia or the East Indies, 2 in Europe, 3 widely distributed.

1. *Eleusine indica* (Linnaeus) Gaertner (Pl. IX, *Db*).

Annual; culms 50 ± cm. tall, glabrous; leaves crowded in the lower part of the stem, narrowly linear, up to 20 + cm. long, subglabrous or with a few scattered hairs on the surface; ligule membranous, 1 ± mm. high, sheaths crowded below, overlapping, keeled, pilose or hyaline on the margin; spikes 2-6 in number, up to 7 + cm. long, digitate, commonly with a single lateral spike some distance below; spikelets closely imbricate on 1 side of the rachis, 3-5-flowered, 6 ± mm. long; glumes boat-shaped, with a scabrous median vein and hyaline margins, 3 ± mm. long, awnless; caryopsis broadly ellipsoidal, 1 ± mm. long, black, rugose, enclosed in a loose membranous pericarp.

Marquesas, Hivaoa, Atuona, November 23, 1921, Quayle, no. 812; Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 725; Uapou, September 7, 1922, W. B. Jones, no. 1098. Rapa, Quayle, no. 353; Raivavae, May 6, 1922, no. 473. Galapagos Islands, January 25, 1926, A. Stewart, no. 1259. Rapa,

June 6, 1921, Stokes, no. 14; August 9, 1921, and January 6, 1922, Stokes, nos. 105 and 448. Austral Islands, Raivavae, March 9, 1922, Stokes, no. 26; Rimatara, March, 1921, Stokes, no. 37; Tubuai, April, 1922, R. T. Aitken, no. 916; reference types.

A cosmopolitan weed of recent introduction in the Marquesas, where it is common around all trading ports; widely distributed in the Pacific islands. Native names are *tutae menemene* in Hivaoa, Marquesas, and *matie* in Tubuai, Austral Islands.

24. DACTYLOCTENIUM Willdenow

Resembling *Eleusine* somewhat, but the rachis prolonged beyond the spikelets, and 1 or more of the glumes provided with an awn. Of African origin.

1. *Dactyloctenium aegyptiacum* Willdenow (Pl. IX, Dc).

Dactyloctenium aegyptium (Linnaeus) Richter, in Hitchcock (21, p. 161).
Eleusine aegyptiaca Desfontaines.

Cynosurus aegyptius Linnaeus, in Drake (15, p. 261).

Ctenium moukahivense Steudel, in Jardin (24, p. 27).

Annual; culms 10-30+ cm. tall; leaves 13 ± cm. long, 3 ± mm. wide, thinly pilose on the surface; spikes 3-6+, 2-4 cm. long, digitate and spreading from the end of the culm; rachis straight, glabrous, narrow, 0.8 mm. wide, pilose at the axil, prolonged 3 ± mm. beyond the spikelets; spikelets greatly compressed laterally, 3 mm. in length, crowded on the under side of the rachis, 3-4-flowered, but the florets progressively reduced centripetally, with the result that only 1-3 of the inferior florets are fertile, the others being more or less reduced and vestigial; glumes all compressed and pocket-shaped, the 2 basal ones empty, 2 mm. long, scabrous on the keel, 1-veined, the superior with a curved awn 1-2 mm. in length; glume of inferior flower 3 mm. long, mucronate, the keel winged and spinulose-serrate, 3-veined but the two lateral veins indistinct; palea broadly ovate, 2-veined, the 2 keels winged, folded; 3 stamens; stigmas short, plumose; caryopsis free from pericarp at time of maturity, somewhat fattened, subspherical, 0.8 mm. in diameter, amber-colored, rugulose; second floret nearly the same as the inferior one but slightly reduced.

Marquesas, Nukuhiva, western part, arid grass region, June 20, 1921, F. Brown, no. 718 F; Nukuhiva, Taiohae, coastal region, June 20, 1921, F. Brown, no. 718 B. Uahuka, southern part, April 24, 1921, F. Brown, no. 359. Tuamotus, Fangatau, April 10, 1921, F. Brown, no. 323, reference types.

Pantropic, of probably aboriginal introduction in the Marquesas, where it is common from sea level to an altitude of 800+ meters. It now furnishes valuable pasture for horses and cattle in the semiarid interior plains. Also occurs in the Galapagos, Society Islands, Philippines, and Hawaii. The native name is *piripiri* in the Marquesas; the English name is crowfoot grass.

25. CYNODON Persoon (Capriola Adanson)

Spikelets 1-flowered; terminal floret vestigial; spikes digitate. Species 14, of which 11 belong to the Old World; the following cosmopolitan:

1. *Cynodon dactylon* Persoon.

Capriola dactylon (Linnaeus) Kuntze.

Culms wiry, branching, creeping, forming a compact turf; stems ascending, 20 + cm. high; leaves rather thin, distichous, linear, 3-6 + cm. long, with a few scattered hairs or subglabrous; sheaths overlapping, subglabrous or pubescent; ligule ciliate; spikes 2-6, digitate, 2-4 cm. in length; rachis scabrous; spikelets single, sessile, imbricate in 2 series on 1 side of the rachis, broadly lanceolate, 2 mm. long, compressed, 1-flowered; glumes 3, the 2 basal ones empty, narrow, boat-shaped, 1.5 ± mm. in length, 1-veined, persistent after the fall of the floral glume and floret; third glume pocket-shaped, 3-veined, 2 mm. long, ciliate on the keel; palea subequal to the glume, 2-veined; stigmas 0.6 ± mm. in length, protruding from the sides of the spikelet.

Marquesas, Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 706; Nukuhiva, Hakau, June 9, 1921, F. Brown, no. 413; reference types.

Pantropic; probably introduced in the Marquesas in comparatively early times, where it is well established near dwellings throughout the islands. Excellent pasture for horses and cattle, but limited in quantity; extensively cultivated as a lawn grass. The native name is *punie*; the English name, Bermuda grass.

TRIBE 8. HORDEAE

Herbs; spikelets with 1 to several fertile flowers, sessile, opposite depressions in the primary rachis; rachilla commonly jointed above the 1 or 2 persistent outer empty glumes, extending beyond the attachment of the fertile flower.

26. LEPTURUS R. Brown

Annual or perennial herb; stems freely branched at the base; leaf narrow or of medium width; inflorescence spicate, cylindrical terminal; rachis articulate and brittle at the nodes; spikelets single at each node, subsessile, alternate, partly included in the internodal cavity of the rachis; flowers 2, rarely 3; lower flower close to the primary rachis, bisporangiate, fertile; second flower superior, fertile or vestigial; third flower subterminal on the short rachilla, vestigial; lower (empty) glumes 1 or 2, thick, indurated, 5- to many-veined, commonly persistent; fertile glume relatively short, thin, 3-veined; palea hyaline, 2-veined; 3 stamens; 2 styles, nearly 1 mm. in length; stigmas plumose, brown, 1 ± mm. in length; caryopsis glabrous.

About 10 species, widely scattered and isolated in Asia, Europe, Africa, America, Australia, and the coral islands of the Pacific; not collected in the Marquesas.

1. *Lepturus repens* R. Brown (fig. 12).*Monerma repens* (R. Brown) Beauvois.

Perennial; stems caespitose, 10-80+ cm. in height, creeping at the base, leaf-bearing to within a short distance of the inflorescence; leaf blades linear to linear-lanceolate, acuminate, acute, 5-35+ cm. in length, 2-8+ mm. in width, flat or convolute, attenuate toward the junction with the sheath, the surface glabrate, puberulous, or scabrous, weakly spinulose serrate along the margin; ligule membranous, entire or ciliate on the margin, 0.5-3 mm. long; sheaths compressed, glabrous or glabrate; spike slender, cylindrical, 5-15 ± cm. in length, 1-2+ mm. in diameter; flower-bearing internodes of the rachis 5 ± mm. long, concave on one side, glabrous to puberulous, brittle at the nodes; spikelets single at each node, alternate, subsessile, partly included in the internodal cavity and covered by the indurated lower glume, 2-3-flowered; lower flower attached to the primary rachis, bisporangiate, fertile; second flower vestigial or fertile, attached to the slender rachilla at a distance of 1 ± mm. from the lower flower; third flower commonly absent, vestigial, and subterminal on a short prolongation of the rachilla when present; a single outer glume, linear, acute, acuminate or awn-bearing, 5-20+ mm. in length, 1 ± mm. in width, thickened and indurated with sclerous pulvinus at the base, many-veined and convex on the outer surface, concave on the inner surface, persistent, glabrate or puberulent, closely appressed, covering the internodal cavity; fertile glume relatively short, 3-6 mm. long, thin, 3-veined, glabrate or puberulent; palea of nearly the

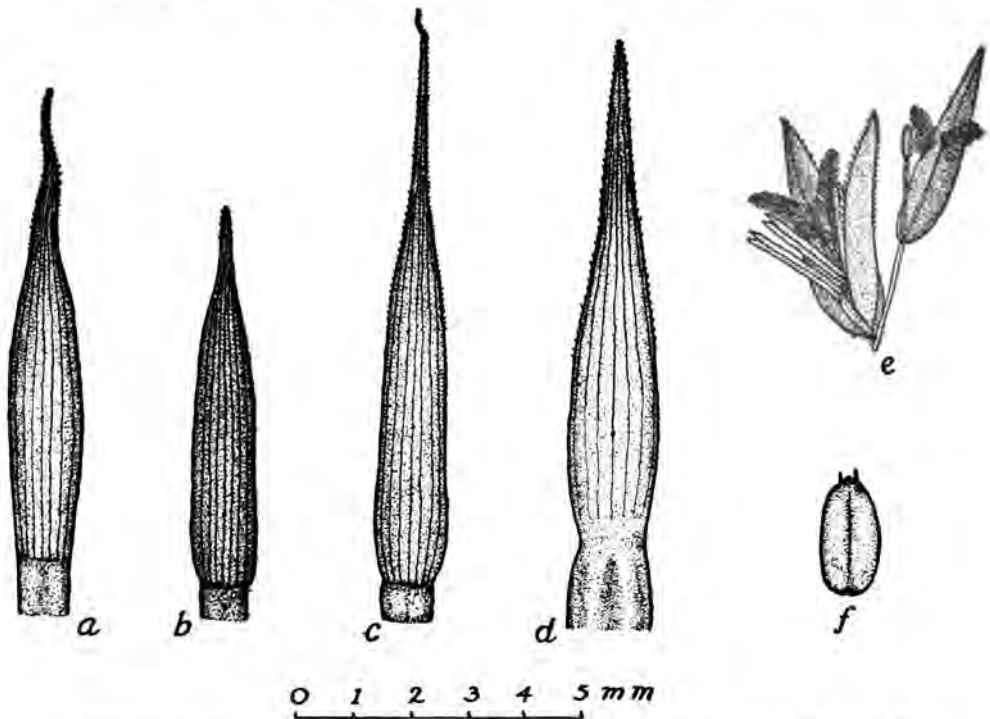


FIGURE 12.—Characters of *Lepturus repens*: a, outer glume of var. α , western Tuamotus; b, outer glume of var. β , eastern Tuamotus; c, outer glume of var. γ , Mangaeva; d, outer glume of var. η Takuera, north central Tuamotuan Archipelago; e, spikelet of var. η , with two fertile flowers and one vestigial flower; f, caryopsis of var. η .

same length and texture as the fertile glume, 2-veined; rachilla produced for a distance of 1 or 2 short internodes beyond the base of the lower flower, commonly bearing a single vestigial floret near the end, in a few specimens a second fertile flower and a third vestigial flower; 3 stamens; stigmatic branches 2, subsessile, plumose, $1.5 \pm$ mm. in length; caryopsis subcylindrical, $2 \pm$ mm. in length, glabrous, brown, rounded and bi- or tri-apiculate at the end; endosperm abundant, rich in starch and aleurone; starch grains subcircular, $7 \pm \mu$ in diameter, with a hyaline center on treatment with iodine.

Shores and islands of northern Australia; coral islands of Malaysia and the Pacific; not collected in the Marquesas.

The following regional varieties or elementary species occur:

KEY

- 1. Spikelets commonly with 2 fertile flowers.....4. var. η
- 1. Spikelets with 1 fertile and 1 vestigial flower (2)
- 2. Outer glume 7-20 + mm. in length, tapering to a slender awn or awn-shaped tip (3)
- 2. Outer glume 5-9 mm. in length, acute or mucronate (4)
- 3. Fertile glume $4.5 \pm$ mm. in length.....3. var. γ
- 4. Ligule $2 \pm$ mm. in length.....1. var. α
- 4. Ligule less than 2 mm. in length (5)
- 5. Ligule $1 \pm$ mm. in length.....2. var. β
- 5. Ligule $0.5 \pm$ mm. in length (6)
- 6. Leaves 7-35 + cm. in length, flat.....var. *palmyrae* (Brown, 7)
- 6. Leaves $10 \pm$ cm. in length, convolute.....var. *maldenensis* (Brown, 7)

1. *Lepturus repens* R. Brown var. α , new variety (fig. 12, a).

Plants $30 \pm$ cm. in height; leaf blades short, 5-10 + cm. long, flat or somewhat convolute, puberulous to glabrate; ligule hyaline, $2 \pm$ mm. in length; spikes $6 \pm$ cm. in length; rachis puberulous to glabrate; spikelets with a single fertile flower and a second vestigial floret; outer glume 7-9 + mm. in length, minutely puberulous near the end; inner glume and palea $3.5 \pm$ mm. in length, the glume minutely puberulous or ciliate in the upper portion.

Tuamotus, western part, Arutua, February 2, 1923, R. H. Beck, no. 1875, type. Tuamotus, Makatea, August 18, 1922, Jones, no. 903; Ahii, August 26, 1919, Jones, nos. 948 and 959; Tikei, August 31, 1922, W. B. Jones, nos. 1046 and X2. Maria, June, 1922, Quayle, no. X5; Timoe, April 25, 1922, Quayle, no. X6; Ducie, Quayle, no. X7; Tureia, June 19, 1922, Quayle, No. 518; Vana Vana, June 22, 1922, Quayle, no. 538; Tahanea, March 9, 1923, Quayle, no. 1990; Hiti, May 5, 1923, Quayle, nos. 2050 and 2061; Raroia, May 12, 1923, Quayle, no. 2089; Matahiva, summer of 1923, Quayle, no. 2203; reference types.

Distributed throughout the Tuamotus and atolls of the Society Islands.

2. *Lepturus repens* R. Brown var. β , new variety (fig. 12, d, e, f).

Very similar to var. α , except that the ligule is $1 \pm$ mm. long, entire or ciliate; outer glume $7 \pm$ mm. in length.

Tuamotus, eastern part, Marutea, Quayle, no. X1, type. Tuamotus, Takaroa, August 28, 1922, W. B. Jones, no. 985; Maturei Vavao, nos. X3 and 406; Ahunui, June 22, 1922, Quayle, no. 551; Parao, June 27, 1922, Quayle, no. 571; Nengo Nengo, June 29, 1922, Quayle, no. 583; Ahii, February 6, 1923, Quayle, nos. 1892 and 1894; Takaroa, March 1, 1923, Quayle, no. 1938; Takapoto, April 3, 1923, Quayle, no. 1965; Kauehi, March 3, 1923, Quayle, no. 1970; Fakareva, 1923, Quayle, no. 2027; Faaite, April 26, 1923, Quayle, no. 2038; Tuanaki, May 3, 1923, Quayle, no. 2045; Hao, 1922, Stokes, no. X; reference types.

Distributed throughout the Tuamotus, where it is best represented in the central islands.

3. *Lepturus repens* R. Brown var. γ , new variety (fig. 12, c).

Stems prostrate, creeping, with erect branches $20 \pm$ cm. in height; leaf blades 5-10 + cm. long, flat or convolute, scabrous on the surface; ligule short, $0.5 \pm$ mm. in height, hyaline, minutely ciliate; spikes $9 \pm$ cm. in length; spikelets with 1 fertile and 1 vestigial flower; outer glume $10 \pm$ mm. in length, with a narrow awl-shaped puberulent tip; fertile glume and palea $4.5 \pm$ mm. long.

Mangareva, Aukena Island, altitude 3 to 4 meters, April 30, 1922, E. H. Quayle, no. 442, type. Tuamotus, Timoe, no. X; Manihi, Quayle, no. X4 (20 cm. tall, leaves $5 \pm$ cm. long, fertile glume 3 mm. in length); Vahanga Island, June 12, 1922, Quayle, no. 492 (dwarf, $15 \pm$ cm. tall, outer glume $7 \pm$ mm. long); Tenarunga, June 13, 1922, Quayle, no. 502 (outer glume 6 mm. long, leaves slightly scabrous); Fakareva, April 20, 1923, Quayle, no. 2031. Austral Islands, Rurutu, Varoia, January 12, 1921, Stokes, no. 7.

Area of distribution includes southeastern Tuamotus, Mangareva, and Austral Islands.

4. *Lepturus repens* R. Brown var. η , new variety (fig. 12, d, e, f).

Culms $50 \pm$ cm. in length, glabrate; leaf blades 3-10 + cm. long, 2.5 + mm. wide, flat, glabrate; ligule long, $3 \pm$ mm., hyaline; spikes $10 \pm$ cm. in length, relatively thick, $2 \pm$ mm. in diameter; rachis glabrate; spikelets with 1 fertile and 1 vestigial floret, or more commonly with 2 fertile flowers and a third vestigial floret; outer glume $9 \pm$ mm. long, minutely puberulent toward the tip; fertile glumes 3.5-4 mm. in length, minutely ciliate; caryopsis large, $2 +$ mm. in length, $1 \pm$ mm. in diameter, biapiculate, glabrous, brown.

Tuamotus, north-central part, Takurea (Takoume), Quayle, no. 2075, type.

Remarkable for the occurrence of 2 fertile flowers in the spikelet, each producing a mature caryopsis; not specifically distinct, however, from *L. repens*, some of the spikelets containing 1 fertile and 1 vestigial floret as in the species; other characters agree perfectly with the species.

Native names are *matie* in Hao, Tuamotus; *nianamu* in Tahiti and *emoku* in the Tuamotus, according to Drake (15, p. 263).

TRIBE 9. BAMBUSEAE

27. SCHIZOSTACHYUM Nees

Spikelets 1-flowered; 6 stamens; 4-6 empty glumes; tall shrubs, the internodes hollow; wood hard.

About 26 species, 24 of which occur in tropical Asia or the region of the East Indies.

1. *Schizostachyum glaucifolium* Munro.

Perennial, with hollow stems 3-10 meters high and up to 7 cm. in diameter; wood hard, strong, forming an outer zone 2-4 mm. thick; leaves narrowly lanceolate, 8-25 + cm. long, 2-3 + cm. wide, rounded at the base and contracted into a petiole $5 \pm$ mm. in length, tapering into a long, acuminate, convolute apex, glabrous on the surface except near the apex where the surface is scabrous; leaf margin scabrous; midvein rather prominent, with 9 or 10 less prominent veins on each side; ligule narrow, thin, less than 1 mm. in height, fimbriate or ciliate; sheaths glabrous, finely striate.

Marquesas, Nukuhiva, July 18, 1921, F. Brown, no. 524 (foliage) and no. 1139 (wood); reference types.

Plants growing in exposed situations rarely exceed 5 meters in height; but clumps in moist, shaded localities reach a height of 10 + meters. No specimens were found in flower, although a large clump along the Omoa-Ouia trail of Fatuhiva had recently passed through the flowering stage. The native names are *kohe* in the Marquesas; *'ofe* in Tahiti [according to Henry (20, p. 66) *'ohe* was the old name in Tahiti, *'ofe* the new name, having superseded *'ohe*]; *'ohe* in Hawaii; *mativa* in Nukuoro, Caroline Islands. The English name is bamboo.

The Marquesans distinguished five varieties: *kohe hatu*, wood zone thick; cavity relatively small, useful for strong poles or tubes; *kohe kohitaha*, wood zone thin, useful for light poles and tubes; containers for cooking food or boiling water made from large stems. (F. Brown, no. 1139. Nukuhiva); *kohe ma'oi*, stems tall, slender, useful for poles. (F. Brown, no. 524, Nukuhiva); *kohe puokuikui*, internodes short; and *kohe toake*, stems with 3 or 4 ridges on the side.

The fact that the Tahitians distinguished 3 main varieties has been recorded by Henry (20, p. 66); none of these were found in the Marquesas.

This plant, which is of little economic value, was cultivated by the ancient Marquesans, who used the stem for poles, tubes, and containers for cooking food or boiling water, and the wood for fishhooks. Houses are now constructed of the split stems. The outer tissues of the stem are separated into ribbon-like strands, used in fine weaving. For this purpose, an internode is opened longitudinally and spread out flat. After drying slightly, under pressure, thin ribbon-like layers, which are strong, flexible, and nearly white, with a high luster, can be separated with the blade of a knife. At the pres-

ent time, this material is used for weaving fine hats for men and women, or to make a pattern in or trimmings on others woven from *Pandanus*. Such hats command a good price in European trade.

Frequently found in all inhabited valleys of the Marquesas, from altitudes of 10 to 500 meters. It does not occur in areas of indigenous vegetation, but on the sites of ancient native plantations, suggesting aboriginal introduction, the source of which remains uncertain. Collected by others in the Society Islands, Fiji, Samoa, and Hawaii.

FAMILY 3. CYPERACEAE

Herbs, a few woody plants, with sympodial rhizomes, triangular stems, grasslike leaves; sheaths closed; inflorescence paniculate, subumbellate, spicate or capitate; flowers monosporangiate or bisporangiate; glumes imbricate or 2-ranked; perianth composed of bristles or scales, or absent; $3 \pm$ stamens; anthers attached by the base; ovulary unilocular, uniovulate, 2-3-carpellate; styles 2-3 parted; fruit a nut; embryo more or less completely surrounded by the endosperm.

KEY

- | | |
|---|-----------------------|
| 1. Glumes 2-ranked (2) | |
| 1. Glumes not 2-ranked (3) | |
| 2. Spikelets many (5-100+) flowered, the glumes finally brown.....1. | Cyperus |
| 2. Spikelets 1-2-flowered, the mature glumes white or light-green.....2. | Kyllinga |
| 3. Florets bisporangiate or partly monosporangiate (4) | |
| 3. Florets monosporangiate.....9. | Carex |
| 4. Style deciduous from the achene (8) | |
| 4. Base of style enlarged, persistent as a beak or tubercle at the apex of the achene (5) | |
| 5. Hypogynous bristles present(7) | |
| 5. Hypogynous bristles absent (6) | |
| 6. Leaves flat or terete.....7. | Cladium |
| 6. Leaves convolute.....8. | Gahnia |
| 7. Involucral bracts present.....6. | R(h)ynchospora |
| 7. Involucral bracts absent.....4. | Eleocharis |
| 8. Style thickened at the base.....3. | Fimbristylis |
| 8. Style not thickened at the base.....5. | Scirpus |

TRIBE 1. SCIRPOIDEAE

Flowers bisporangiate in 5-100+ flowered spikelets (1-2-flowered in *Kyllinga*, *Courtoisia*, and section *Mariscus* of the genus *Cyperus*).

I. CYPERUS Linnaeus

Stem triangular, with grasslike leaves at the base and linear bracts at the base of the branches of the inflorescence; spikelets composed of few to

many florets; glumes 2-ranked; florets bisporangiate, without hypogynous scales or bristles; stamens 3 or less; style 2-3-parted, not enlarged at the base; achene triangular, commonly more or less enclosed in the wings of the rachis.

Although approximately 700 species have been reported with a primary concentration (290 ±) in America and a secondary concentration (260 ±) in Africa and Madagascar, the genus is not well represented in Polynesia. Only 17 occur in Hawaii and in the Galapagos, 10 in the Society Islands. At least 3 endemic species, evidently an American derivative, occur in the mountain flora of the Marquesas. The lowland species, *C. (Mariscus) pennatus*, was doubtless introduced from the western Pacific by the ancient Marquesans, as it follows the route of Polynesian migration in nearly every part of the Pacific. About 50 species occur in each of the following countries: Asia, Australia, Malaysia, and Europe.

In all species collected in the Marquesas, the small cone-shaped spikelets bearing the seed fall away entire at maturity. As they will float for a long time, they can be dispersed by ocean currents. Also their small size adapts them to accidental distribution by man.

The native name is *mo'u (mouku)*, for all species in the Marquesas.

KEY

- 1. Inflorescence capitate (2)
- 1. Inflorescence umbellate (3)
- 2. Spikelets few, 1-3.....13. **Cyperus tenellus**
- 2. Spikelets numerous (7)
- 3. Spikes simple or sparingly branched (6)
- 3. Spikes branched (4)
- 4. Spikelets lanceolate in outline..... 4. **Cyperus pennatus**
8. **Cyperus macrellema**
- 4. Spikelets linear or linear lanceolate in outline (5)
- 5. All secondary branches spicate throughout..... 3. **Cyperus strigosus**
- 5. Some secondary branches spicate in the upper portion only.....
2. **Cyperus ferax**
- See also.....9. **Cyperus consocius**
- 6. Spikelets several-flowered (9)
- 6. Spikelets 1-flowered.....14. **Cyperus umbellatus**
- 7. Spikelets 2-flowered (8)
- 7. Spikelets 1-flowered.....12. **Cyperus montona**
- 8. Leaves as long as the culm.....10. **Cyperus marquisensis.**
- 8. Leaves longer than the culm.....11. **Cyperus rapensis**
- 9. Umbel with rays, up to 8 + cm. in length..... 1. **Cyperus feani**
- 9. Umbel contracted (10)
- 10. Style 2-parted..... 7. **Cyperus polystachyua.**
- 10. Style 3-parted (11)
- 11. Culms enlarged at base..... 5. **Cyperus rotundus**
- 11. Culms not enlarged at base..... 6. **Cyperus compressus**

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1. *Cyperus feani*, new species (Pl. X, A).

Perennial; stem erect, herbaceous, $80 \pm$ cm. high, acutely triangular; leaves numerous, linear, flat, approximately twice the length of the stem, $2 \pm$ cm. broad, coriaceous, the margin and midrib scabrous, especially toward the apex, the surface glabrous; bracts leaf-like, $8 \pm$ in number, $7-80+$ cm. in length, the longest being approximately 3 times the length of the inflorescence; inflorescence a large compound umbel of $11 \pm$ slender, unequal, ascending or somewhat spreading rays, each ray enclosed at the base in a long truncate or ligulate closed sheath; $6 \pm$ of the rays, $20-25+$ cm. in length bearing a subumbellate cluster at the top; subumbels with $6 \pm$ unbranched secondary rays $2-8+$ cm. long, $3 \pm$ of which greatly exceed the others in length, spicate in the distal half only, sheathed at the base, and commonly subtended by a narrow, linear bract approximately half the length of the branch, the central axis spicate from the branched base to the apex; short primary rays of the umbel either simple and spicate in the apical portion or with a few short secondary spicate branches; spikelets linear terete, somewhat curved, $2 \pm$ long by $15 \pm$ mm. wide, spreading, not crowded ($14 \pm$ cm. in each), 5-9-flowered, articulated and deciduous above the 1 or 2 empty scalelike glumes at the base, commonly with a subulate bracteole 1-5 mm. in length at the base; glumes 9-veined, 3-5 mm. long, closely appressed, decurrent, broadly ovate, obtuse or slightly mucronate, light greenish-brown; achene oblong, trigonal, one-half the length of the glume, partly enclosed in the thin wings of the rachis; stamens 3 in number, deep brown, with slender flat filaments; styles with 3 exserted branches.

Marquesas, Hivaoa, Feani [Keiani], altitude 800 meters, December, 1921, F. Brown, no. 968, type.

The species is closely allied to *C. auriculatus* Nees of the Hawaiian islands and *C. lomentaceus* Nees and *C. ferax* Richardson of tropical America. It agrees with *C. consocius* Steudel, according to Jardin (24, p. 52), in height and unbranched spikes, but differs in having longer primary bracts and longer spikelets. It is not associated with *C. macreilema* Steudel *C. pennatus* Lamarck?. (See Drake 15, p. 227).

Endemic in the Marquesas, rarely found in high elevation in the cloud zone. The native name is *mo'u* or *mou'u* in Hivaoa, Marquesas Islands.

2. *Cyperus ferax* Richardson.

Culm triangular; leaves as long as the culm, margins scabrous; umbel compound, primary rays $10-15+$ cm. long, branched in the upper portion, forming subumbellate clusters; involucre bracts $7 \pm$, very unequal, the longest several times the length of the umbel; subumbellate clusters with 2-3 secondary bracts, each nearly equal in length to the branch which it subtends; secondary rays 3-4 cm. long, commonly branched; short secondary and tertiary rays spicate throughout; long secondary rays spicate in the distal half; spikelets terete, 7-9, rarely 17-flowered; fertile glumes oval, 5-7-veined, reddish brown; achene triangular, one-third to one-half the length of the glume, closely clasped in the wings of the rachis; 3 stamens; style 3-parted.

Austral Islands, Raivavae, Stokes, no. 67, Rapa, October 31, 1921, Stokes, no. 381. Rapa, 1922, Quayle, no. 338 (without spikelets, probably belongs to this species); Rapa, Morongata, July 15, 20, and August 25, 1921, Stokes, nos. 71 and 150 (not sufficiently mature for accurate determination, but probably referable to this species); reference types.

The species *C. feani*, which resembles *C. ferax* somewhat, differs in the unbranched spikes and shorter secondary bracts. The spikes of *C. consocius* are simple.

Native names are *maoe uupoo* in Raivavae; *pupalila* and *ehe* in Rapa. An extract from the root was valued as a medicine; also, the lower part of the stem served as food in Rapa.

Pantropic; credited to the Marquesas by Drake (15, p. 237) but not collected; occurs in Rapa and Raivavae.

3. *Cyperus strigosus* Linnaeus.

Stem $1 \pm$ meters high; leaves equal to the stem in length, $1 \pm$ cm. broad, the surface scabrous toward the apex; involucre leaves many, unequal, the longest greatly exceeding the umbel which is bi-tricomound; primary rays 10-12 in number, 10-18 cm. long, enclosed at the base with ligulate sheaths, branched in the upper portion, forming a subumbellate or subpaniculate cluster, the lowest 3-4 branches longest; all branches spicate throughout; spikelets spreading, linear-lanceolate, 7-10 mm. in length, compressed; glumes 6-8, 5-6 mm. long, acute, 7-9-veined; achene triangular, clasped by the wings of the rachis, half the length of the glume; 3 stamens; style 3-parted.

Credited to the Marquesas by Drake (15, p. 239); not collected.

4. *Cyperus pennatus* Lamarck (Pl. X, B).

Cyperus pennatus Lamarck: Kunth (26, vol. 2, p. 80).

Perennial; stem triangular, $60 \pm$ cm. high; leaves linear, $7 \pm$ mm. broad, longer than the stem, scabrous on margin and midvein; primary bracts $6 \pm$, very unequal, the longest 40-80+ cm. in length; umbel composed of 6 to many rays 6-9 cm. long, compact, subglobose; rays stiff, subpaniculately branched from the base upward or only in the upper portion, the branches with or without a subulate bract at the base, covered throughout with spikelets; spikelets numerous, often somewhat crowded, narrowly ovoid, slightly compressed or subterete, 5-8+ mm., rarely 9-13 mm. in length, composed of 7-12 glumes, $4 \pm$ at the base of the spikelet empty, the 2 lower ones scalelike and persistent on the rachis after the fall of the remainder of the spikelet; fertile glumes broadly ovate, obtuse, $3 \pm$ mm. long, reddish-brown, indistinctly 9-veined; 3 stamens, the filaments flat; style with 3 stigmatic branches; achene $1 \pm$ mm. in length, broad, acutely triangular, dark-brown.

Society Islands, Tahiti, March, 1921, no. 285; Marquesas, Nukuhiva, Mauu, June 20, 1921, F. Brown, no. 438; Uahuka, April 25, 1921, F. Brown, no. 380; Uapou, swamps, September 7, 1922, Quayle, no. 1077; Eiao, bank of stream at coconut bay, altitude $5 \pm$ meters, September 28, 1922, Beck, no. 1542 d; Hututu, September 27, 1922, Jones, no. 1544; Hivaoa, Hanaipa, October 30, 1922, Quayle, no. 1639; Uahuka, November 9, 1922, Jones, no. 1655; Tahuata, Mount Amatea, altitude 700 to 1000 meters, November 27, 1922, Jones, no. 1783; Fatuhiva, Hanavave, altitude 100 meters, December 2, 1922, Jones, no. 1823. Society Islands, Melutia, altitude 30 meters, January 23, 1921, Stokes, no. 122; Rurutu, March 3, 1921, Stokes, no. 188. Reference types. Specimens from Hivaoa and Tahuata, Marquesas, have relatively small spikelets.

This is one of the principal plants from which the Marquesans and other Polynesians obtained fiber for use in straining fluids. The stem yields, when shredded and the mass thoroughly washed in running water, a quantity of fiber. This, felted together in such a manner that the fibers cross each other at right angles forming small meshes between, was used to compress and strain the juice from the grated coconut meat or the crushed tissues of medicinal plants. Also, the triangular stem was used by fishermen for stringing and carrying fish. Similar uses were made of the plant by the Hawaiians and Tahitians. Native names are *mou'u* or *mouku* in the Marquesas; *mou'u* in Rurutu, Austral Islands; *mo'u ha'ari* in Tahiti; *ahuawa* in Hawaii.

This species is common in valleys of all the Marquesan islands, from the borders of streams to an altitude of 1000 meters. It is absent from areas of indigenous vegetation, but forms part of the vegetation now covering ancient native plantations. Areas of over 100 meters in extent are covered by this sedge, which forms tufts or gregarious associations in the semiarid area of western Nukuhiva. It also occurs in Eiao and Hututu, which are uninhabited at present but were inhabited, at least temporarily, by the ancient Marquesans. Native of southern Asia and Malaysia; of probable aboriginal introduction in the Marquesas and other parts of Polynesia; occurs also in Australia.

5. *Cyperus rotundus* Linnaeus.

Chlorocyperus rotundus Palla.

Rhizome creeping, forming cormlike enlargements, which have a pungent taste and odor; culm 1-3 + cm. tall, slender, triangular; leaves linear, 3 ± mm. broad, commonly shorter than the culm, scabrous near the apex; inflorescence subumbellate, the 3-8 unequal rays slender, 1-3 + cm. long, with 4 ± spikelets near the end; involucre bracts 2-6 +, leaf-like, the longest subequal to or somewhat longer than the umbel; spikelets sessile, linear-lanceolate, compressed, 5-20-flowered, 1-2 cm. long, with 2 empty membranous glumes at the base; rachis of spikelet with thin hyaline wings; glumes broadly ovate, 3 mm. long, obtuse, not mucronate, deep cherry-red with a green 3-veined keel; 3 stamens; style 3-parted.

Marquesas, Nukuhiva, Taiohae, October 1, 1921, F. Brown, no. 784, reference type.

Pantropic; probably of recent introduction in the Marquesas, where it is common near trading ports; widely spread in the Pacific islands.

6. *Cyperus compressus* Linnaeus.

Annual; stems erect, slender, 30 ± cm. high, triangular, with convex sides; roots fibrous; leaves filiform, shorter than the culms as a rule, prominently keeled, sheathing the culm to a distance of 3 ± cm. from the base; inflorescence composed of 6-12 sessile spikelets, the umbel simple or with a single ray 3 ± cm. long bearing 3 ± spikelets at the end; involucre composed of 3 ± leaf-like bracts, minute or up to 10 + cm. in length; no involucre; rachis of spikelet with or without wings; glumes carinate sub-

coriaceous, acuminate, 3 mm. in length, approximately 3 times as long as the deep-brown, broadly obovate, triangular achene; style 3-parted.

Marquesas, Nukuhiva, Taiohae, September 5, 1921, F. Brown, no. 606, reference type.

Pantropic; presumably a weed of ancient aboriginal introduction in the Marquesas, where it is frequently found on all the islands at low altitudes. Probably introduced in the Tuamotus. The native name is *haiki* in the Marquesas.

7. *Cyperus polystachyus* Rottboell.

Glabrous perennial; culm 30-70 cm. in height, rather slender, sharply triangular, smooth; leaves narrowly linear, shorter than the culm, smooth or minutely spinulose-scabrous along the margin and keel; sheaths thin, 1-7 + cm. in length; inflorescence umbellate, contracted, 2-3 + cm. in width, the rays very short or the branches subsessile; involucre bracts 3-6, of which 1 or more greatly exceeds the umbel in length; spikelets linear-lanceolate, compressed, with 16-30 + flowers; rachis commonly winged; glumes boat-shaped, mucronate, $2 \pm$ mm. in length, 3-veined near the center, green to light-brown; stamens commonly 2; style commonly 2-parted; achene elongated, trigonal or biconvex, $1 \pm$ mm. long, dark-gray to brown, minutely punctate under a lens.

Tuamotus, west-central part, Takapoto, March 3, 1923, Quayle, no. 1950, reference type. This specimen approaches var. *laxiflora* of Bentham.

Pantropic; widely distributed in the Pacific islands, occurring in the East Indies, Australia, Hawaii, Society Islands, Tuamotus, Washington Island, and other islands.

8. *Cyperus macreilema* Steudel.

"One meter in height; culm triangular at base of umbel; bracts 50 \pm cm. long, very scabrous on the under surface; spikes free, without secondary bracts."—Jardin (24, p. 52).

This insufficiently described species is referred to *C. pennatus* by Drake (15, p. 238). In all specimens here referred to *C. pennatus*, secondary bracts are present—a character which excludes them from *C. macreilema*. From Jardin's observations (24, p. 52) it appears that the natives used the plant in the same manner as they did *C. pennatus*. This seems to indicate that it was closely related to and may have been only a form or variety of that species.

The fibrous strands from the stem were matted together and used by the natives to filter kava and coconut milk. Endemic in the Marquesas, where the native name is *mouku*, according to Jardin.

9. *Cyperus consocius* Steudel.

"Stem $1 \pm$ meters in height, sharply triangular throughout; bracts at base of umbel less than 50 cm. long; umbel compound; spikes simple, not branched, longer than the secondary bracts, which are rudimentary in the lower spikes; leaves far less scabrous than in *Cyperus macreilema*."—Jardin (24, p. 52).

Drake (15, p. 237) refers this species to *C. ferax*, which seems doubtful, from the fact that the tertiary branches are well developed in the umbel of *C. ferax* and the spikes are branched. *C. consocius* is distinguished "par ses épis simples." It may very well be allied to the endemic *C. feani* and its relatives, from which it differs in having longer involucre bracts. However, none of the plants collected agrees in detail with the description given by Jardin.

Endemic; Nukuhiva, Marquesas, associated with *C. macreilema*.

10. *Cyperus marquisensis*, new species (Pl. X, C).

Perennial; culms $1 \pm$ meters in height, sharply triangular, slightly scabrous; leaves linear, approximately as long as the culm, $1 \pm$ cm. wide, the margin and midrib scabrous near the apex, the surface glabrous; involucre bracts $12 \pm$, leaf-like, very unequal, 2-90+ cm. in length; spikes of the same number as the bracts, subglobose, 12-15+ cm. in diameter, sessile, tightly crowded in a subglobose head $3 \pm$ cm. in diameter; spikelets numerous, crowded, compressed, curved, $7 \pm$ mm. long, commonly with 2 fertile florets; glumes $8 \pm$ in number, the 2 basal ones empty and persistent for a time after the fall of the remainder of the spikelet, the inferior subulate, as long as the spikelet, the superior concave, acute, thin, one-half the length of the inferior; inferior fertile glume $6.5 \pm$ mm. long, concave, 9-veined; superior fertile glume $4.5 \pm$ mm. in length; 3 or 4 glumes at the apex of the spikelet are sterile and progressively reduced in size; achene $2 \pm$ mm. long, triangular, deep reddish-brown, partly enclosed in the delicate wings of the rachis.

Marquesas, Nukuhiva, 1921, Simeon Delmas, no. 55, type. Marquesas, Eiao, altitude 400 meters, September 20, 1922, Jones, no. 1536, reference type; probably referable to this species.

This species is allied to *C. feani*, though entirely different in superficial appearance. Its distinguishing characters are the reduced rays of the inflorescence, the 10 glumes of *C. feani* being reduced to 8 in *C. marquisensis*, of which only 2 bear fertile flowers. A second species, *C. hawaiiensis* Mann (29, no. 511) which is closely related to *C. marquisensis* occurs in Hawaii. The spikes of the Hawaiian relative are somewhat less compact and less crowded in the head. Endemic in the Marquesas; collected on Nukuhiva and Eiao; frequently found in open, moist situations at an altitude of 600+ meters; probably of American origin. The native name is *mo'u tona* in the Marquesas.

11. *Cyperus rapensis*, new species (Compare Pl. X, C).

Perennial herb, culm $15 \pm$ cm. tall, sharply triangular, smooth; leaves $12 \pm$ mm. wide at the base, over twice the length of the culm, tapering gradually to a filiform point, sharply spinulose-serrate along the margin and keels, especially near the tip, coriaceous, smooth on the upper surface; inflorescence capitate, subglobose, with foliose bracts 1-25+ cm. long at the base of the head and between the $10 \pm$ dense, cluster-like branches of which the head is composed; axis of the capitate branches $5 \pm$ mm. in length, $2 \pm$ mm. in thickness, bearing the spirally arranged spikelet scars; spikelets 1- or 2-flowered, compressed, curved, or straight, $4 \pm$ mm. in length; glumes $7 \pm$, thin, brown; basal glumes 2, attached below the articulation and persistent for a time after

the fall of the rest of the spikelets, the lower subulate as long as or longer than the spikelet, the second glume ovate-lanceolate, 2-veined on each side, thin, one-half the length of the spikelet; third glume boat-shaped, acute, $4 \pm$ mm. long, thin, 2-veined on each side; fourth glume attached $1 \pm$ mm. from the base of the spikelet, fertile or empty; glumes 5-7, sterile, progressively reduced in size; rachis winged; flowers bisporangiate; 3 stamens; filaments $4 \pm$ mm.; anthers narrowly linear, $1 \pm$ mm. in length; style $2 +$ mm. in length, bearing 3 slender stigmatic branches $3 \pm$ mm. long; achene ellipsoidal, $2 \pm$ mm. in length, trigonal, yellowish-brown, partly enclosed by the wings of the rachis.

Rapa, 1922, E. H. Quayle, no. 339, type.

Closely allied to and intermediate between *C. marquisensis* and *C. moutona* of the Marquesas. It may be readily distinguished from these by the leaves, which are over twice the length of the culm.

Endemic in Rapa.

12. *Cyperus moutona*, new species (Pl. X, D).

Perennial; stems slender 20-50 + cm. in height, erect, glabrous; leaves subequal to the stem in length, $5 \pm$ mm. wide at the base, rather firm in texture, tapering to a long filiform apex, scabrous toward the apex on the margin and keel, glabrous on the surface; bracts of the involucre leaf-like, $10 \pm$, very unequal, 1-40 + cm. in length, stiff, straight, inclined downward at an angle of $45 \pm$ degrees; inflorescence capitate, globose, $2 \pm$ cm. in diameter, similar in external appearance to that of *C. marquisensis*; spikes subglobose, of approximately the same number as the bracts, crowded; spikelets 1-flowered, compressed, curved, 3-4 mm. long; glumes $7 \pm$; the 2 basal ones sterile and persistent for a time on the rachis after the fall of the remainder of the spikelet, the lower subulate and nearly as long as the spikelet, the other lanceolate, 1-veined, approximately one-half the length of the spikelet; fertile glume as long as the spikelet, curved; glumes in the apical portion $4 \pm$, all sterile, progressively reduced in size; 3 stamens; style 3-parted; achene $2 \pm$ mm. in length, triangular, dark-brown.

Marquesas, Fatuhiva, Omoa-Hanavave trail, January 20, 1922, altitude 600 \pm meters, F. Brown, no. 943, type.

The species is closely allied to *C. marquisensis*, from which it is readily distinguished by its smaller size, stiff reflexed bracts, and small 1-flowered spikelets; also closely allied to *C. rapensis* of the Austral Islands.

Used by the natives for medicinal purposes. From the crushed tissues of the inflorescence a juice was obtained, which, mixed with water, was taken internally as a remedy for various forms of illness. The native name is *mo'u tona*.

Endemic; occasionally found in moist, open situations, Omoa Valley, Fatuhiva, Marquesas.

13. *Cyperus tenellus* Linnaeus f.

Caespitose annual; roots slender, numerous; culms numerous, filiform, slender, lax, 6-12 + cm. in height, $0.4 \pm$ mm. in diameter; leaves reduced to basal sheaths, $1.5 \pm$ mm. in length, bearing a setaceous blade at the opening; spikelets commonly solitary, rarely 2-3 in number, terminal, but appearing lateral due to the single erect involucral bract,

sessile, narrowly ovate, $4 \pm$ mm. in length, $2 \pm$ mm. in width, greatly compressed, 10-18-flowered; involucre a single tardily deciduous, erect, bract, appearing as a continuation of the stem beyond the junction of the inflorescence; glumes boat-shaped, keeled, glabrous, broadly ovate, obtuse or mucronulate, 7-11-veined, $1.5 \pm$ mm. long, greenish, with a hyaline margin; stamens commonly 3 in number, filament $1 \pm$ mm. long, the anthers narrowly linear, $1 \pm$ mm. long; style $1 \pm$ mm. long with 3 slender stigmatic branches $1 \pm$ mm. long; achene acutely trigonal, $1 \pm$ long, much shorter than the glume obscurely scabropunctate.

Rapa, 1922, Quayle, no. 352, reference type.

The Rapa plant agrees fairly well with Steudel's description (44, part 2, p. 16), which is based, apparently on material from South Africa. The form which occurs in New Zealand and Australia differs somewhat, according to Cheeseman's description (10, p. 215) and the specimens examined.

The area of distribution includes South Africa and Rapa.

14. *Cyperus umbellatus* Bentham.

Culms $45 \pm$ cm. tall, triangular, glabrous; leaves shorter or longer than the culm, spinulose serrate on the margin and keel; spikelets numerous, crowded in cylindrical spikes 15-25 mm. in length, $9 \pm$ mm. in diameter, sessile or pedunculate-umbellate; involucre bracts $5 \pm$ mm. broad, longer than the umbel; spikelets 3-4 mm. in length, commonly 1-flowered, the 2 outer glumes short, empty, attached below the articulation; flowering glume as long as the spikelet enclosing the flower and the winged glumelike end of the rachis; style 3-parted; achene elongated, trigonal, nearly as long as the glume in which it is enclosed.

Society Islands, Tahiti, Papeari, October, 1909, J. E. Tilden, no. 64. Society Islands, Tahiti, Mount Aorai, altitude 600 meters, October 5, 1921, Quayle, no. 115. Rapa, 1922?, Quayle, no. 247. Austral Islands, Rurutu, February 18, 1921, Stokes, no. 79, reference types.

The native name is *mauuu* in Rapa and in the Austral Islands. A fiber obtained from the culm was used for straining the milky juice from coconut meat. A pantropic weed.

2. KYLLINGA Rottboell

Inflorescence compact, globose; spikelets compressed, 1-2-flowered; glumes 2-4, distichous, carinate; caryopsis compressed; style 2-parted; stamens 1-3.

Approximately 50 species, chiefly African and American, few representatives in the East Indies and Asia, none in Australia, 4 species pantropic.

KEY

- | | | |
|--|----|------------------------------------|
| 1. Glumes 5-veined, hyaline-white..... | 1. | <i>Kyllinga brevifolia</i> |
| 2. Glumes 7-veined, spotted with purple..... | 2. | <i>Kyllinga monocephala</i> |

1. *Kyllinga brevifolia* Rottboell.

Perennial; culms $15 \pm$ cm. tall, triangular, with 1 basal leaf commonly shorter than the culm; rhizome creeping; inflorescence capitate; $1 \pm$ cm. in diameter, white or green-

ish-white, with 3 long involucre bracts at the base; spikelets compressed; glumes 2 or 3, the inferior, when present, minute, scalelike; the 2 superior ones carinate; with a green, spinulose keel, mucronate, 5-veined hyaline-white; 3 stamens; caryopsis compressed, subcircular, mucronate; style deeply 2-parted.

Marquesas, Uapou, September 7, 1922, W. B. Jones, no. 1097; Fatuhiva, Omoa-Hanavave trail, January 20, 1922, F. Brown, no. 920; Nukuhiva, Hakau, July 1, 1921, F. Brown, no. 689. Tuamotus, Fangatau, April 10, 1921, F. Brown, no. 325. Tuamotus, Takapoto, March 3, 1923, Quayle, no. 1694; Society Islands, Tahiti, October 5, 1921, Quayle, no. 14; Marquesas, Nukuhiva, Taiohae, Simeon Delmas, no. 67, reference types.

The native names are *haiki kuhane*, *okiohina*, *maniania* in the Marquesas; *mauku* in Fangatau, Tuamotus; *mau'u noanoa* in Rurutu, Austral Islands. A medicine was made from this sedge by the natives.

Cosmopolitan in the Tropics; of common occurrence in the Tuamotus and other Pacific islands. In the Marquesas gregarious at the lower levels, where it forms a turf.

2. *Kyllinga monocephala* Rottboell.

Perennial, with a creeping rhizome; culms triangular, compressed, $20 \pm$ cm. tall, leaf-bearing at the base; leaves shorter or longer than the culm, spinulose-serrate toward the apex; inflorescence capitate, $1 \pm$ cm. in diameter, greenish; spikes 1-flowered, compressed; glumes 2-4, the lower ones, if present, reduced, linear-lanceolate, one-half the length of the upper glumes; upper glumes 7-veined, spinulose-serrate, dotted with purple; 2 stamens; style 2-parted; caryopsis compressed, elliptical in outline, apiculate.

Marquesas, Nukuhiva, Taiohae, June 1, 1921, F. Brown, no. 752. Austral Islands, Rurutu, January 12, 1921, A. M. Stokes, no. 23. Rapa, Anarua, September 13, 1921, Stokes, no. 183.

The native names are *haiki kuhane*, *okiohina*, *maniania* in the Marquesas; *laau moanoa*, *mauu*, and *matu* in Rurutu; *matie upo'o* in Tahiti, according to Setchell (58), and *mo'u upo'onui*, according to Nadeaud (44). A native medicinal plant in the Marquesas and Rapa.

Pantropic; abundant in the Marquesas, but less than *K. brevifolia*.

3. *FIMBRISTYLIS* Vahl

Spikelets terete, many-flowered, solitary to several, capitate or umbellate; glumes spirally arranged, imbricate, without setae or calycine scales; 1-3 stamens; style 2-3-parted, enlarged at the base and wholly deciduous from the lenticular achene.

Over 100 species, widely distributed in the Tropics, with America, Africa, and Australia leading in number of species.

KEY

1. Inflorescence umbellate (2)
1. Inflorescence a single terminal spike (4)
2. Style glabrous.....5. *Fimbristylis cymosa*
2. Style pubescent (3)
3. Lamina of leaves small, setose.....1. *Fimbristylis nukahivensis*
3. Leaves one-third to two-thirds the length of the culm.....6. *Fimbristylis annua*
4. Spikelets single (5)
4. Spikelets capitate.....5a. *Fimbristylis cymosa* var. *microcephala*
Plant less than
5. 40 ± cm. in height.....2. *Fimbristylis separanda*
5. Plant less than 40 cm. in height (6)
6. Plant 20 ± cm. in height.....3. *Fimbristylis tertia*
6. Plant 10 ± cm. in height.....4. *Fimbristylis marquesana*

1. *Fimbristylis nukahivensis* Steudel.

Perennial; roots slender, numerous, from a caespitose base; culm filiform, erect, 15-40 ± cm. in height, glabrous, sclerous, longitudinally furrowed; leaves 1-3 +, the lamina setose or filiform, commonly 1 ± cm. long, rarely longer, and up to one-half the length of the culm, minutely spinulose-serrate on the edges; sheaths thin, brown, puberulent or glabrate, 1-4 + cm. in length; inflorescence umbellate, with one sessile spikelet and 1-4 + slender rays 1-2 + cm. long, each bearing a spikelet at the end; 2 or more setose bracts 1 ± cm. in length, at the base of the umbel and spikelets; spikelets acutely ovoidal, up to 13 + mm. long; glumes broadly ovate, 2 ± mm. wide, 2.7 ± mm. long, obtuse or subacute, terminating in a mucro 0.3 ± mm. long, carinate, chestnut-brown, over twice the length of the achene, minutely ciliate or glabrate near the apex; achene broadly obovoidal, 1 ± mm. long, light-yellow, longitudinally striate under a lens, the striae formed by transversely rugulose ridges; style pubescent, slightly thickened at the base, 1 ± mm. in length with 2 spreading stigmatic branches of 1 ± mm.; 3 stamens; filaments 2 ± mm. in length.

Marquesas, western Nukuhiva, Mauu, altitude 800 ± meters, June 20, 1921, F. Brown, no. 716; Nukuhiva, Nakatea, July 20, 1921, F. Brown, no. 515; reference types.

Description amplified by author from reference types. It closely resembles *F. annua*, Roemer and Schultes and may possibly be only a variety of that species; also closely allied to *F. hawaiiensis* Hillebrand and *F. annua* (*F. polymorpha* Boeckler) from Hawaii. Dry plants are valued as a filling for the native bed. The native name is *haiki kuhane* in the Marquesas.

Endemic; occasionally found in open situations, arid grassland of western Nukuhiva; not collected on other islands of the Marquesas.

2. *Fimbristylis separanda* Steudel.

"Smaller than *nukahivensis*, the spikelets commonly single and larger [than those of *nukahivensis*]."—Jardin (30, pp. 27, 52).

Description amplified by F. Brown:

Perennial, 15-40 + cm. tall; roots small, numerous from caespitose base; stem filiform, glabrous, sclerous, longitudinally furrowed; leaves 1-3 +, reduced, commonly less than 1 cm. in length, minutely spinulose-serrate on the edges; sheaths thin, 1-4 + cm. long, brown, puberulous or glabrate; spikelets, acutely ovoidal, 2-13 + mm. in length, commonly single and sessile at the end of the culm, rarely with a short ray bearing 1 or 2 spikelets at the end; 2-3 + subulate bracts at the base of the spikelet, commonly shorter, rarely longer than the spikelet; glumes broadly ovate, obtuse or subacute, broad and truncate at the base, $2.7 \pm$ mm. in length, $1.7 \pm$ mm. in width, glabrous or subglabrous, brown with a yellowish-brown border; 3 stamens; filaments compressed, $4 \pm$ mm. in length; style pubescent, $2 \pm$ mm. in length, with 2 slender branches $2 \pm$ mm. in length; achene broadly obovate, $1 \pm$ mm. in length.

Marquesas, interior of Nukuhiva, Tovii, near Moku-au-toto, altitude 1800 \pm meters, in wet places, July 15, 1921, F. Brown, no. 501 (plants 15 \pm cm. high); Tovii, altitude 1000 \pm meters, in open moist places, July 15, 1921, F. Brown, no. 516 (plants 40 \pm cm. high); Nukuhiva, eastern Hakau, trail to Taiohae, altitude 900 meters, June 6, 1921, F. Brown, no. 769 (plants 40 + cm. high); Tovii, September, 1922, Quayle, no. 1296 (plants 40 cm. in height; achenes typical, broadly obovate, 1 mm. in height, brownish-yellow, conspicuously punctate under a lens); Nukuhiva, Tovii, September, 1922, Quayle, no. 1266 (plants 50 + cm. high); Uapou, Mount Tekahoipu, altitude 800 to 1000 meters, Quayle, no. 1142 (culms tall, slender, 50 \pm cm. in height), reference types.

This species has been reduced to *F. nukahivensis* Steudel by Drake (15, p. 242), but specimens collected by the writer and others indicate that *F. separanda* is a good species. It is distinguished from *F. nukahivensis* by the commonly solitary spikelets, subglabrous glumes, short almost obscure mucro, long filaments and style. The achene is small and apparently undeveloped in all specimens except Quayle no. 1296 from Nukuhiva. In this the achene is broadly obovate, $1 \pm$ mm. in height, brownish-yellow, and conspicuously punctate under a lens. The height of the plant and size of the spikelet, given as specific characters by Jardin, are variable characters of little systematic value.

Native names are *haiki kuhane* (bed for spirits), *mokutoto*, and *mutie* in the Marquesas. The natives used this sedge, to a limited extent, as filling for the native bed. Endemic in the Marquesas; collected only on Nukuhiva and Uapou.

3. *Fimbristylis tertia* Steudel.

"Six to eight inches in height; spikelets solitary, subtended by a foliose bract 2-5 times as long as the spikelet; leaves linear, subequal to the culm."—Jardin (24, pp. 27, 55).

Description amplified by F. Brown:

Perennial; roots numerous, slender, from a caespitose base; culms filiform, 15-20 cm. in height, minutely appressed spinulose-denticulate on the angles, longitudinally furrowed;

leaves $3 \pm$, linear filiform, shorter than, equal to, or somewhat longer than the culm, minutely spinulose-serrate along the margin; sheaths $20 \pm$ mm. in length, thin, subglabrous; spikelets commonly solitary and sessile, rarely with a second terminating a short umbellate ray, acutely ovate, $7 \pm$ mm long, $4 \pm$ mm. wide, subtended by a setose bract 2-3 + times the length of the spikelet; glumes broadly ovate, obtuse, obscurely mucronulate, broad and truncate at the base, $2.5 \pm$ mm. long, $2 \pm$ mm. wide, minutely ciliate along the margin, thin, yellowish with reddish-brown longitudinal striations; 3 stamens; filaments $3 \pm$ mm. in length; style pubescent, $1.5 \pm$ mm. in length, with 2 slender branches $1 \pm$ mm. in length; achene obovate $0.8 \pm$ mm. long, yellow.

Marquesas, Uapou, Motuoa (islet south of Uapou), September 8, 1922, W. B. Jones, no. 1111, reference type.

This species has been referred by Drake (15) to *F. juncea* var. *β polytrichoides*. This is admissible, as *tertia* is clearly more closely allied to *nukahivensis*, which he admits as a distinct species with *separanda* as a synonym.

4. *Fimbristylis marquesana* Steudel.

Fimbristylis marquesana Steudel: Jardin (24, pp. 27, 52).

Perennial, 7-12 cm. in height; culm deeply furrowed, glabrous; sheaths more or less pubescent; leaves longer than the culms, subpuberulent; spikelets solitary, ovate, acute, subtended by a setaceous bract somewhat longer than the spikelet; glumes ovate, acute, puberulous, longer than the achene; style 2-parted. Description adapted from Steudel (43, pt. 2, p. 107).

Endemic in the Marquesas; collected by Jardin on Nukuhiva.

5. *Fimbristylis cymosa* R. Brown.

Description amended by F. Brown:

Perennial; caespitose; culms 10-50 + cm. in height, compressed, furrowed; leaves numerous, shorter than the culm, linear, 0.5-3 + mm. broad, thickened in the middle, stiff, scabrous or minutely spinulose-serrate near the apex, acute or abruptly acuminate or subtruncate; spikelets obovoid, 3-7 + mm. long, crowded in heads at the ends of umbellate rays or reduced to a single terminal head; involucre bracts subulate; glumes ovate, obtuse or acute, 2-3 mm. in length, thickened along the keels, not mucronate, 5-7-veined; stamens 3 or reduced to 2 or 1; style shortly exerted, 3-parted, thickened at the base, glabrous, deciduous; achene obovoid, 0.6-0.8 mm. long, trigonal, smooth, yellow to brown when ripe.

Area of distribution includes Australia and the Pacific islands; represented in Hawaii by the endemic varieties: *umbellato-capitata* (Mann) Hillebrand and *pycnocephala* (Hillebrand) Kükenthal.

5a. *Fimbristylis cymosa* R. Brown var. *microcephala*, new variety.

Description amended by F. Brown:

Perennial; culms erect, 10-30 + cm. tall, from a caespitose base, compressed, furrowed, glabrous, $1 \pm$ mm. wide; roots numerous, fine; leaves crowded at the base, about half as long as the culm, rather stiff, narrowly linear, 0.5-1 + mm. wide, curved or straight, concave above, convex below, minutely spinulose-serrate along the margin especially near the tip, the surface glabrous; sheaths up to 20 mm. long, thin, brown, clasping the base of the culm; spikelets 10-30 +, ovoid, obtuse, $6 \pm$ mm. long, sessile,

crowded in a subspherical head $1 \pm$ cm. in diameter; involucre bracts 3-9 +, 2 of which are, as a rule, slightly longer than the head; glumes broadly ovate, obtuse or subacute, broadly truncate at the base, $2 \pm$ mm. long, carinate, not mucronate, glabrous, brown, faintly 5-7-veined, with a broad hyaline border; stamens 1-2, rarely 3, the filaments $1.5 \pm$ mm. long; style glabrous, 0.8 mm. long, with 3, rarely 2, slender branches $1 \pm$ mm. long; achene broadly obovate, $0.8 \pm$ mm. in height, trigonal, dark-brown, smooth.

Tuamotus, western part, Manihi, 1922, Quayle, no. 1903, type ($15 \pm$ cm. high; leaves narrow, $0.8 \pm$ mm. wide). Tuamotus, western part, Kawehe, March 9, 1923, Quayle, no. 1982; Fakareva, Quayle, no. 2029. Society Islands, Scilly (Fenuarua), January 3, 1922, Quayle, no. 231. Society Islands, Quayle, no. 195 ($20 \pm$ cm. tall; leaves relatively stiff, $1.3 \pm$ mm. wide; spikelet $4 \pm$ mm. long; 1, rarely 2 stamens; filaments $2 \pm$ mm. long; anther $1 \pm$ mm. long; achene $0.9 \pm$ mm. long; style 1 mm. long, with 3 branches 1.8 mm. long). Society Islands, Tahiti, June 5, 1922, Setchell, no. 285, reference types.

This variety is closely allied to the slightly more primitive variety *pycnocephala*, of Hawaii, from which it is readily distinguished by its narrower leaves, smaller heads and spikelets, relatively short glumes, longer involucre bracts, and fewer stamens; spikelets sessile in all specimens examined. In var. *pycnocephala* the leaves are 2-3 mm. wide; heads 10-20 mm. in diameter, sessile or radiate; a single involucre bract; 3 stamens, with filaments 3 mm. in length; achene $0.6 \pm$ mm. long.

Area of distribution includes the Society Islands, western Tuamotus, and Baker Island.

6. *Fimbristylis annua* (Allioni) Roemer and Schultes.

Fimbristylis diphyllo Vahl.

Caespitose; culms slender, $50 \pm$ cm. tall, longitudinally furrowed, glabrous; leaves few, narrowly linear, shorter than the culm, $1.5 \pm$ mm. wide, abruptly pointed, minutely spinulose-serrate along the margin, subglabrous on the surface; sheaths up to $10 +$ cm. long, pilose at the throat; umbels 1-8, the rays slender, 1-4 + cm. long; spikelets ovoid, $8 \pm$ mm. long; glumes broadly ovate, $3 \pm$ mm. long, acute, glabrous, thin; stamens commonly 1 (2? or 3?); style $2 \pm$ mm. long, flattened, pubescent, the 2 stigmatic branches short and slender; nut broadly obovoidal in shape, $1 \pm$ mm. in height, shortly stalked, light-yellow, distinctly $12 \pm$ striate on each face, and tuberculate in the apical portion.

Austral Islands, Raiivavae, 1922, Quayle, no. 254; reference types.

There are several varieties or forms; the form described, characterized by striate achenes with apical tubercles, is common also in the Malay region. A widely distributed weed, probably of early introduction in Polynesia.

4. ELEOCHARIS (Heleocharis) R. Brown

Perennial, rarely annual, herbs, with creeping rhizomes; leaves reduced to sheaths at the base of the culm; spikelets single, terminal, without in-

volucre; glumes spirally arranged, imbricate in several ranks, all fertile except 1 or 2 at the base; hypogynous bristles commonly present, $6 \pm$, retrorsely barbate; 3 stamens; style 2-3-parted, dilated at the base, which persists as a tubercle at the apex of the achene; nutlet obovoidal, trigonal, or plano-convex.

A genus of wide distribution, comprising $100 \pm$ species best represented in America; many hydrophytic or bog species.

1. ***Eleocharis caribaea* Blake var. *stokesii***, new variety (Pl. XIV, B).

Culms $15 \pm$ cm. tall; inner sheath $15 \pm$ mm. in length, the opening very oblique, terminating in an acutely pointed toothlike projection 1-15 mm. long; spikelet 5 mm. long, 3 mm. wide; glumes 2 mm. long, purple, with a hyaline border and greenish keel; 3 stamens with filaments 1.5 mm. long and anthers 0.5 mm. long; 6 hypogynous bristles 1-16 + mm. in length; style relatively long, 1 mm. in length, abruptly dilated at the base with 2, rarely 3, stigmatic branches $0.9 \pm$ mm. long; achene shortly stalked, obovate, 0.7 mm. long, jet-black, tipped by the light-colored, tubercle-like, persistent base of the style.

Rapa, in marshes near sea level, September 14, 1921, Stokes, no. 180, type. The native name is *tumutumulaupo* in Rapa.

5. SCIRPUS Linnaeus

Annual or perennial herbs; leaves at the base of the culm, reduced to sheaths in many species; inflorescence terminal, appearing lateral in many species due to the erect stemlike involucre bract; spikelets several, rarely solitary, sessile or pedicellate, many-flowered, terete; glumes imbricated in several ranks; flowers bisporangiate, rarely monosporangiate; hypogynous bristles present or absent; 3 stamens or less; style 2-3-parted, not enlarged at the base, wholly deciduous or a portion persistent as a tubercle at the apex of the nutlet; nutlet obovoid, complanate or trigonal.

A large genus of world-wide distribution, comprising $150 \pm$ species.

The following species belong to section *Isolepis*, a group of relatively small plants in which the spikelets are solitary or capitate; hypogynous bristles absent, rarely present.

1. ***Scirpus nodosus* Rottboell.**

Culms erect, stiff, terete or somewhat compressed, 30-90 + cm. tall, $3 \pm$ mm. in diameter, perennial from a thick nodose rhizome $1 \pm$ cm. in diameter; leaves reduced to 3 \pm sheaths, 1-8 + cm. tall, at the base of the culm; inflorescence capitate, subspherical, 8-16 + mm. in diameter, appearing lateral due to the erect stemlike involucre bract 10-30 + mm. long; spikelets numerous, ovoid, 4-5 mm. in length, several-flowered; glumes broadly ovate, broad and truncate at the base, concave, obtuse or mucronulate, rather thin, brown; hypogynous bristles absent; 3 stamens; style short ($0.3 \pm$ mm.) with 3 slender stigmatic branches of $2 \pm$ mm. long; nutlet obovoid, $1 \pm$ mm. in length, obscurely trigonal, brown or black, smooth, shining.

Rapa, Teakaulua, on exposed ridges, altitude 40 + meters, no. 65 (90 ± cm. tall; involucre bract 20 ± mm. in length; heads small, 8 ± mm. in diameter; spikelets 4 ± mm. in length; glumes 2.5 ± mm. long, mucronulate; 3 stamens, the filaments 3 ± mm. long; style 0.3 ± mm. long, with 3 stigmatic branches, 1.5 ± mm. long; nutlets shortly stalked, 1 ± mm. long, obscurely trigonal, jet-black, shining). Rapa, Teutu, seashore, 1921, Stokes, no. 98 (60 ± cm. tall; bract 20 ± mm. long; heads 11 ± mm. long; spikelets 5 ± mm. long; glumes 2.5 ± mm. long, keeled, mucronulate; 3 stamens, the filaments 3 ± mm. long; style 0.2 ± mm. long, with 3 stigmatic branches 2 ± mm. long; achene 1 ± mm. long, obscurely trigonal, jetblack, shining; stalk 0.3 ± mm. in length).

Rapa, Tauna, a coral islet outside the main harbor (Tairirau), from coral substratum, 1921, no. 451, no. 458 (40-60 + cm. tall; bract 25 ± mm. long, heads large, 15 ± mm. in diameter, composed of numerous tightly crowded spikelets; spikelets 5 ± mm. long; glumes 3 ± mm. long, mucronulate, lightly keeled; 3 stamens, the filaments 3 ± mm. long; style 0.2 ± mm. long, with 3 stigmatic branches 2 ± mm. long; achene apiculate, obscurely trigonal, 1 ± mm. in height, jet-black; resembles Tilden no. 327 from Stewart Island). Austral Islands, Raivavae, 1922, Stokes, no. 269. Rapa (?), 1922, Quayle, no. 347. New Zealand, Stewart Island, March, 1910, Tilden, no. 327 (65 ± cm. tall; heads large, 17 ± mm. in diameter; involucre bract 22 ± mm. long; spikelet 5 ± mm. long; glume 2.5 ± mm. long, thin, slightly keeled, mucronulate; filaments 3 ± mm. long; anthers 1.4 mm. long, mucronate; achene obscurely trigonal, 1 ± mm. long, jet-black, shortly stalked; style 0.3 ± mm. long, the 3 stigmatic branches 1.5 ± mm. long). Juan Fernandez, Masatierra, altitude 600 ± meters, December 12, 1916, C. Skottsberg, no. 179 (50 ± cm. tall; bract 20 ± mm. long; head 13 ± mm. long; spikelets 5 ± mm. long; glumes 3 ± mm. long, mucronulate; style 0.3 ± mm. long, the 3 stigmatic branches 2 mm. long). Reference types.

The native names are *moku* and *mo'u* in Rapa. A medicinal plant in Rapa, the scraped tissues of the stem being applied to the back to alleviate pain.

Circumpolar in the South Temperate Zone, occurring in southern Africa, southern Australia, Tasmania, Stewart Island, North and South islands of New Zealand (altitude 0 to 700 meters); Chatham Islands; Lord Howe Island; Norfolk Island; Kermadec Islands; Raivavae and Tauna Reef of the Austral region; Rapa; Juan Fernandez (altitude 600 meters); St. Helena; Amsterdam.

TRIBE 2. RHYNCHOSPOROIDEAE

Spikelets 1-5-flowered; glumes spirally arranged, imbricate, the lower 1 or more empty; flowers monosporangiate or bisporangiate; hypogynous bristles 6 ± in number, rarely absent.

6. R(H)YNCHOSPORA Vahl

Annual or perennial herbs with leafy stems; spikelets subterete, 1-5-flowered, disposed in clusters, heads, or panicles; glumes spirally arranged, imbricate, 1 or more of the lower ones relatively short and empty; hypogynous bristles $6 \pm$; flowers monosporangiate or bisporangiate; 3 stamens; style 2-parted, enlarged at the base; fruit (nutlet) compressed, ovate, obovate, or elongated in outline, beaked by the persistent base of the style.

A tropical American genus of $150 \pm$ species; very poorly represented in Africa, Asia, and Europe; 1 or more species in Australia, Malaysia, Madagascar, Ceylon, Hawaii, and the Marquesas; $2 +$ species pantropic.

1. R(h)ynchospora marquisensis, new species (Pl. XII).

Perennial; culm 30 cm. tall, triangular, leaf-bearing throughout; leaves linear, flat, $12 \pm$ mm. broad at the base, up to $40 +$ cm. in length, all except a few at the base extending beyond the culm, tapering gradually to a long slender apex, pale yellowish-green when dry, minutely spinulose-serrate or nearly smooth along the margin and under surface of the midvein; cauline leaves sheathing the stem and closed at the sides for a distance of $20 \pm$ mm. above the node, the lamina of the basal ones $40 \pm$ cm. long, the upper ones progressively smaller, becoming bractlike in the panicle branches; basal leaves numerous, $10-40 +$ cm. long; inflorescence thrysopaniculate, $9 \pm$ cm. in length, the panicles 3-5 in number, suberect from the sheathing base of the subtending foliose bract, $6 \pm$ cm. in length, with a peduncle of $3 \pm$ cm. long, the branches of the third order bracteolate, bearing crowded spikelets throughout; spikelets (spikelet-like cymes) ellipsoidal, acutely pointed, $7 \pm$ mm. long, $1.5 \pm$ mm. broad; glumes 7-9, imbricate, attached at short intervals to axis $2 \pm$ mm. in length, firm in texture, brown, broadly lanceolate, subacutely pointed, broad and truncate at the base, 1-veined, terminating in a mucro 1 mm. long, the lower (outer) glumes 3-ranked, empty, relatively small, increasing progressively from $1 \pm$ mm. at the base to the 3d, or 4th or 5th, which is $5.5 \pm$ mm. in length and $3 \pm$ mm. broad; the upper (inner) 4 in number, 4-6 mm. long, up to $3 +$ mm. wide, imperfectly 2-ranked, the 6th, 8th, and 9th (when developed) fertile, the 7th sterile, clasping the flower of the sixth glume by the margins, the 8th glume fertile, clasping the fertile 9th glume in the inrolled margins; axis of spikelet $2 \pm$ mm. long; flowers bisporangiate, the terminal (3d) included in the terminal (9th) glume, the second in the axil of the 8th glume, the first (lower) in the axil of the 6th glume, clasped above the base of the achene by the inrolled margins of the 7th glume; stamens 3; filaments 8 mm. in length, partly exerted; anthers (from unopened terminal flower) linear, $3.5 +$ mm. in length, soon deciduous; hypogynous bristles 6 in number, $6 \pm$ mm. in length, antrorsely barbulate, slightly exerted from the glume in some of the flowers; style $5 \pm$ mm. in length, 2 with slender branches $3 \pm$ mm. in length; nutlet suborbicular in outline, $1 \pm$ mm. in length and nearly as broad, somewhat compressed, light-yellow, minutely cancellate under a lens, the beak formed by the persistent base of the style approximately of the same length as or somewhat longer than the achene.

Marquesas, Uapou, September 9, 1922, E. H. Quayle, no. 1141, type.

The closest relative of the Marquesan species is *R. stokesiana* of Rapa; also it is closely related to the Hawaiian *R. scleroides* Hooker and Arnott, from which it is distinguished by the smoother leaves, smaller inflorescence, shorter spikelet, shorter axis of spikelet, broader glumes, longer filaments, shorter bristles, shorter style, shorter beak of the achene. In *R. scleroides*

the inflorescence is $30 \pm$ cm. long; style $9 \pm$ mm. long, with branches $3 \pm$ mm. long; filaments $5 \pm$ mm. long; bristles $7 \pm$ mm. long; beak $1.5 \pm$ mm. long; axis $4 \pm$ mm. long.

Endemic in the Marquesas. Collected only on Uapou at altitudes of 800 to 1000 meters.

2. *R(h)ynchospora stokesii*, new species.

Caespitose perennial; culms $70 \pm$ cm. tall, leaf-bearing throughout, all except a few of the basal leaves extending beyond the culm, $4-9 +$ mm. wide, tapering to a long slender tip, sharply spinulose-serrate on the margin and keel, the basal leaves $10 \pm$ in number, $90 \pm$ cm. long; culm leaves $10 \pm$ in number, $90 +$ cm. in length at the base of the culm, diminishing to bracts of $4 -$ cm. in the ultimate branches of the inflorescence; sheaths closed, $7 \pm$ cm. long near the base of the culm, diminishing to 1-cm. in length in the branches of the inflorescence; inflorescence thyrsopaniculate, $20 \pm$ cm. long, composed of $5 \pm$ panicles in raceme-like arrangement, each from the closed sheath of a foliose bract, which exceeds the panicle in length; panicles $4 \pm$ cm. long and nearly as wide supported by slender, naked, suberect branches $3-10 +$ cm. in length; spikelets $40 \pm$ in each panicle, in clusters of $7 \pm$ near the ends of bracteate secondary branches of the panicle; spikelets narrowly ellipsoidal, $1 \pm$ cm. long, 1.3 mm. in diameter, on pedicels $2 \pm$ mm. long, subtended by a setose bracteole approximately twice the length of the pedicel; glumes commonly 9, ovate with a broad truncate base, acute or subacute, the basal glume $2.5 \pm$ mm. in length, 1.3 \pm mm. in width, the succeeding ones progressively larger to the sixth, which is $7.5 \pm$ mm. in length, $3 \pm$ mm. in width, all glabrous, 1-veined, terminating in an outwardly bent mucro 1-2.5 mm. in length, thick and firm in texture, except the ninth, brown, with a thin inrolled hyaline margin; outer glumes commonly 4 in number, empty, imperfectly 3-ranked; inner glumes 5 in number, empty, imperfectly 2-ranked, the fifth to the eighth with a bisporangiate flower in the axil, which is clasped by the inwardly rolled hyaline margins of the succeeding glume; glume-bearing axis $7 \pm$ mm. long; hypogynous bristles 6 in number, $7 \pm$ mm. long; antrorsely barbate; stamens 3 in number, the compressed filaments $9 \pm$ mm. long at maturity, the anthers narrowly linear, $3 \pm$ mm. long; style slender, $5 \pm$ mm. long, with 2 slender stigmatic branches $3 \pm$ mm. in length; nutlet $1.5 \pm$ mm. in length, $0.7 \pm$ mm. in width, slightly compressed, yellow, with faint longitudinal striations beaked by the short ($0.7 \pm$ mm.), thickened base of the style.

Rapa, Pariati, between Kapitanga and Kalele, on side of ridge, altitude $280 \pm$ meters, October 19, 1921, Stokes, no. 362, type. Rapa, Nukumaala, September 21, 1921, Stokes, no. 265 (culm $60 \pm$ cm. in length; leaves $6 \pm$ mm. wide; inflorescence 30 cm. in length; spikelets rather few, $9 \pm$ mm. in length); June 6, 1921, Stokes, no. 3, leaves only.

Very closely related to *R. marquisensis*, from which it differs (1) in height; (2) the sharply serrate leaves; (3) the pedicillate spikelets; (4) the shape and dimensions of the spikelet, glumes, nutlet, and beak; (5) the number of flowers. The glumes are of somewhat the same texture and color as those of *R. marquisensis*, but more compactly inrolled, the inner ones longer and relatively narrow, terminating in a longer mucro.

Measurements (in millimeters) of glumes from typical spikelets are as follows:

Number	Length	Width	Mucro	Contents
1 (basal)	2.5	1.3	1	empty
2	2.6	1.5	1	empty
3	3.1	1.5	1.3	empty
4	4.0	2.0	1.0	empty
5	6.0	2.5	1.0	fertile
6	7.5	3.0	1.3	fertile
7	7.0	2.5	2.5	fertile
8	6.0	2.0	2.0	fertile
9	4.0	2.0	2.0	vestigial flower
10 (vestigial)				

Endemic in Rapa. Native name is *kiekie* in Rapa, a name commonly applied to *Freycinetia* elsewhere in Polynesia. The strong fibrous leaves are used for tying packages of taro.

2a. R(h)ynchospora stokesii forma saxicola, new form.

Culm $20 \pm$ cm. tall; leaves $4 \pm$ mm. in length and 10 cm. in width; inflorescence 10 cm. long; glumes slightly smaller than the typical form.

Rapa, Nukumaala, on face of cliff, by waterfall, altitude 70 meters, September 21, 1921, Stokes, no. 264, type.

This is apparently only a dwarf form of the species. Endemic in Rapa where the native name is *kiekie*.

7. CLADIUM P. Browne

Perennial herbs; leaves terete or flat, 2-ranked; spikelets 1-3-flowered; glumes spirally arranged, imbricate, the 1-4 at the base empty; flowers bisporangiate; hypogynous bristles commonly absent; 3 stamens; style 3-parted, rarely 2-parted, enlarged at the base which persists as a conical beak at the apex of the achene; achene tricostate or trigonal.

Species $50 \pm$, of which nearly half are from Australia (15) and New Zealand (5). The remaining species are widely distributed, with representatives in Malaysia, Polynesia, America, Africa, Asia, and Europe.

KEY

1. Leaves terete..... 2. **Cladium nukuhivense**
 1. Leaves flat (2)
 2. Branches of panicle scabrous..... 1. **Cladium meyenii**
 2. Branches of panicle smooth..... **Cladium angustifolium** (Brown, 7, p. 8)

1. **Cladium meyenii** (Kunth) Drake (Pl. XIII, B).

Baumea meyenii Kunth.

Perennial; stem $1 \pm$ meters in height, nodose, compressed, scabrous on the edges, foliose; leaves flat, linear, $50 \pm$ cm. long, $7 \pm$ mm. wide, short and equitant imbricate

at the base, acute, the veins numerous, fine and subequal, without distinct midvein or keel, pale-green beneath, scabrous; inflorescence paniculate, $3 \pm$ dm. long, subtended at the base by a leaf-like sheathing bract shorter than the panicle, the upper bracts successively smaller, the uppermost ones 1-2 cm. in length; basal branches of the panicle 1 dm. long, zigzag, the upper branches shorter, all compressed, convex on one side, scabrous; spikelets sessile, clustered $5 \pm$ together, the clusters subtended by 1 or 2 sheathing, hispid, 6-veined, reddish bracts, the spikelets reddish-brown, commonly with a single bisporangiate floret; glumes 4-5, boat-shaped, 4 mm. in length, acute, not mucronate, 1-veined; style 3-parted, the enlarged pubescent base persistent as a stout beak on the sharply triangular, reddish, smooth achene; 3 stamens, the flat filaments of nearly the same length as the achene and persistent at the base.

Marquesas, Hivaoa, Feani, altitude 800 meters, December 1921, F. Brown, nos. 974 and 978; Nukuhiva, without locality, September, 1922, Quayle, no. 1303; Nukuhiva, Taiohae, June, 1922, Simeon Delmas, no. 59; reference types.

Area of distribution includes the Marquesas and Hawaii.

2. *Cladium nukuhivense*, new species (Pl. XIII, A).

Perennial gregarious herb; rhizome covered with thin, triangular, striate scales; culm slender, terete, 80-120 cm. tall, nodose; leaves few, terete, $4 \pm$ mm. in diameter, as long as or shorter than the culm, sheathing at the base, tapering to a subulate apex, 1 or more of the basal leaves nearly equal to the culm in length, the remainder having short laminae or reduced to sheaths, the single cauline leaf with a long, closed sheath and short lamina; interior tissues of the stem and leaves pithlike, numerous chambered longitudinally; inflorescence (a) racemopaniculate, 20-50 + cm. in length, nodding at the apex, the branches solitary or few fasciculate, all axillary from sheathing, acuminate, spathe-like bracts 1-6 + cm. in length, the lower branches remote, erect, 10-25 \pm cm. long; spikelets few in number, 6-8 mm. in length, reddish-brown, compactly clustered, $4 \pm$ together, 1-5-flowered, the flowers bisporangiate; scales glumelike, 4-8 mm. in length, the lower 1-3 empty, ovate-acuminate, some mucronate or subaristate, thin, veins 1 to 4 +, pubescent on the outer surface, long-ciliate on the margin; 3 stamens, the compressed filaments elongating to 7 + mm., persistent at the base of the achene; anthers 3 mm. in length, mucronate; style filiform, $3 \pm$ mm. in length, divided into 3, rarely 4, long capillary stigmatic branches $8 \pm$ mm. in length; achene ellipsoidal-triangular, beaked by the slightly enlarged pubescent base of the style.

Marquesas, central Nukuhiva, Tovii, altitude 1000 meters, July 15, 1921, F. Brown, no. 479a, type. Marquesas, Nukuhiva, Tovii, September, 1922, Quayle, no. 1294, reference type.

The species is remarkably close to *C. huttoni* T. Kirk, a snowline plant, which occurs on the border of lakes from sea level to an altitude of 500 + meters in North Island, New Zealand. *C. nukuhivense* is readily distinguished from *C. huttoni* by its fewer, larger, pubescent spikelets, smaller glumes, shorter filaments, anthers, and style, and pubescent base of the style. In *C. huttoni* the spikelets are 4-5 mm. long; style 2 mm. long; filaments 3 mm. long; anthers 2 mm. long; base of style glabrous or glabrate. Therefore *C. nukuhivense*, on account of its closeness to *C. huttoni*, is also

allied to *C. glomeratum* R. Brown, which occurs in Australia, Tasmania, southeastern Asia, Malaysia, Chatham Island, and in New Zealand southward to Stewart Island. (See Cheeseman, 10 p. 233.)

The native name is *mokuaototo* throughout the Marquesas. The Marquesans, particularly the inhabitants of Nukuhiva, were thoroughly familiar with the plant from its occurrence in Tovii. The watery juice from the stem formed a part of some of the native medicines; parts of the plant were worn or carried in the ancient ceremonial rites.

Endemic in the Marquesas, where it was collected only in the high interior of Nukuhiva, the much beloved Tovii of the natives, which was the location of the ancient battle fields of the Nukuhivan tribes. Here it covers a shallow, flat bed, evidently the site of a former crater lake, now practically filled with plant remains. This is the only place in the Marquesas where a true bog and bog flora were found.

8. GAHNIA Forster

Spikelets 1- or 2-flowered, the flowers bisporangiate or, rarely, monosporangiate; glumes 3 to 6+, imbricate in several ranks, the lower ones empty; 3-6 stamens, the filaments greatly elongated in anthesis, persistent at the base of the achene; style 3-parted, the capillary branches simple or dichotomously branched; hypogynous bristles absent; achene triangular, beaked with the persistent thickened base of the style.

Approximately 40 species, over half of which are from Australia (15 or 17 species) and New Zealand (8 species). The remaining species are distributed in Malaysia and Polynesia, with a few in Asia; absent from America, Africa, and Europe.

KEY

1. Inflorescence loosely racemose; nutlet yellow, 3 mm. long... 1. **Gahnia marquisensis**
2. Inflorescence compact, the branches subcapitate;
nutlet red, 6 mm. long..... 2. **Gahnia stokesii**

1. **Gahnia marquisensis**, new species (Pl. XV, A).

Perennial, 80 ± cm. in height; culm subcylindrical, channeled, scabrous on one side, nodose; leaves linear, coriaceous, 1 ± cm. wide at the base, equal to or exceeding the culm in length, sharply spinulose-serrate along the long, convolute-filiform apical portion, the stem leaves with closed sheaths 2 ± cm. long, the basal leaves with open, overlapping sheaths 1 ± dm. in length; inflorescence loosely racemose paniculate, interrupted below, 40 ± cm. in length, narrow, the primary branches single or 2-3 together, 2-8 + cm. long, axillary from sheathing, leaf-like, convolute bracts, which extend beyond the apex of the panicle; spikelets deep-fawn, with a tuft of capillary filaments projecting from the apex; spikelets with a single bisporangiate flower, closely clustered in twos, as a rule, the 1-flowered commonly short-pedicellate; solitary spikelets, as well as the

2- or more-flowered pedicellate or subpedicellate, bi- or tri-spikelet clusters partly enclosed by the spathe-like, subulate-pointed bract; glumes 3 or 4 in number, deep-brown, glabrate or pubescent, the outer exceeding the rest in length, 5-veined, notched in some specimens, terminating in a scabrous, subulate apex; the next somewhat shorter, 3-veined, acuminate; the 1 or 2 innermost flower-bearing glumes about as long as the achene (3 mm.), 1-veined, acute or acuminate; achene obovoid, obtusely triangular, light-yellow, with 3-6 persistent capillary filaments $15 \pm$ mm. in length attached at the base, the apex beaked with the thickened base of the style; style commonly 3-parted, puberulous at the base, the branches simple or bifurcately branched; stamens commonly 3 in number, the anthers mucronate, yellow, the reddish-brown filaments at first equal to the style in length but greatly exceeding it when mature.

Marquesas, Fatuhiva, ridge between Oui and Omoa, altitude $800 \pm$ meters, January, 1922, F. Brown, nos. 991A and B, type. Marquesas, Nukuhiva, September, 1922, Quayle, nos. 1213, 1343, and 1294 (a young specimen differing from the type in the pubescent glumes and pubescent base of the style); Uahuka, October, 1922, Quayle, nos. 1751 and 1831; reference types.

The Marquesan species is distinguished by the number and size of the spikelets, the large outer glume and sheathing bracteole, the long filaments and comparatively small achene; closely allied to *G. schoenoides* of Tahiti, *G. beecheyi* of Hawaii, and *G. javanica* of Malaysia.

The native name is *mo'u* in the Marquesas, where the stout, flexible leaves were used by the Marquesans for binding prisoners of war.

Endemic in the Marquesas; occasionally found in the cloud zone, altitude $800 \pm$ meters; collected on Nukuhiva, Uahuka, and Fatuhiva.

2. *Gahnia stokesii*, new species (Pl. XIV, A).

Perennial herb; culm $50-70 +$ cm. high, nodose, leaf-bearing throughout, subcylindrical, smooth; leaves coriaceous, sheathing at the base, up to $100 +$ cm. in length, convolute, spinulose-scabrous, tapering gradually into long, filiform, drooping tips; inflorescence $10-20 +$ cm. in length, $3 \pm$ cm. in width, composed of $10 \pm$ contracted secondary branches $3 \pm$ cm. long, disposed in raceme-like arrangement, bearing crowded short-stalked or subsessile spikelets, each secondary branch subtended by a foliose bract terminating in a long, drooping, convolute-filiform point $10-15 +$ cm. in length; spikelets $15 \pm$ mm. long, 1-flowered, dark-brown or black; glumes commonly 7-8 in number, imbricate in several ranks, the 2-3 outer ones empty boat-shaped, $1 \pm$ cm. in length, scabrous on the outer surface especially near the apex; the 4th (3d in the 7-glume spikelet) inrolled, flask-shaped, $9 \pm$ mm. long, the neck slender, quill-shaped, scabrous on the outer surface, half the length of the glume, wrapped around the filament and style in anthesis, spreading and long acuminate in fruiting; 5th glume (4th in 7-flowered spikelets) of the same shape as the 4th but smaller, 8 mm. in length, somewhat smoother on the outer surface, contained within the 4th in anthesis, the neck wrapped around the filaments and style, spreading apart and becoming long-acuminate in fruiting; the 3 inner glumes surrounding the flowers, small, scale-like, nearly smooth, obtuse, $2 \pm$ mm. in length during anthesis, growing to $6 \pm$ mm. long in fruiting; stamens commonly 4, the compressed filaments 7-8 mm. long, irregularly sinuate or curved, dark-brown, filiform and downwardly curved at the junction of the anther, persistent at the base of the fruit; anther narrowly linear, $2 \pm$ mm. in length, $0.2 \pm$ mm. in width, sharply acuminate; style 10 mm. long, puberulous, especially at the base, with 3 slender, deciduous, stigmatic

branches $1 \pm$ mm. in length; nutlet ovoid, $6 \pm$ mm. in length, $4 \pm$ mm. in diameter, tipped by the slender, persistent base of the style and bearing the 4 persistent filaments at the base, reddish-brown when ripe, shining; pericarp very thick ($1 \pm$ mm.), hard; seed small, $2 \pm$ mm. in diameter; endosperm abundant, composed of coarse granules of starch $28 \pm \mu$ in diameter, crystalliferous aleurone, and globules of fat.

Austral Islands, Raivavae, Mount Taraia, altitude 300 meters, March 10, 1922, Stokes, no. 38, type. Rapa, Monongota, altitude 250 meters, July 20, 1921, Stokes, no. 91, Austral Islands, Raivavae, 1922?, Quayle, no. 304, reference types.

This species is closely allied to *G. rigida* T. Kirk, of South Island, New Zealand, from which it differs in the relatively large, 2-flowered spikelets and larger nutlets.

The native names are *poekoea* in Rapa and *tutuna* in Raivavae. The leaves served as thatch for houses and for weaving hats in Raivavae. In Rapa a watery extract from the crushed fruits was taken as a purgative.

Endemic in the Austral Islands and Rapa; collected only on Rapa and Raivavae.

TRIBE 3. CARICOIDEAE

Inflorescence spicate, the spikelets unisexual or bisexual; carpellate spikelets commonly 1-flowered, the ovulary enclosed in a saclike perigynium; staminate spikelets composed of 2 or more flowers disposed in staminate spikes or at the apex (rarely at the base) of the carpellate spikes; no hypogynous bristles.

9. CAREX Linnaeus

Inflorescence composed of one or more spikes, which are either staminate or carpellate, or with staminate and carpellate flowers on different parts of the same spike; flowers monosporangiate; 3 stamens or less; ovulary enclosed in a loose membranous perigynium; style 2-3-parted.

Over 1000 species well represented in America, New Zealand (55), and Asia; poorly represented in Africa, Australia (29) and Malaysia. A few species widely scattered in Polynesia.

KEY

1. Spikes rarely over 10 cm. in length (3)
1. Spikes commonly over 10 cm. in length (2)
2. Mouth of perigynium subentire; scales of carpellate flowers mucronate or short-aristate..... 2. **Carex stokesii**
2. Mouth of perigynium subentire or shortly bidentate; scale of carpellate flower long-aristate..... 2a. **Carex stokesii** var. **aristata**
3. Spikes $3 \pm$ cm. in length..... **Carex tahitensis** (Brown, 7)
3. Spikes $5 \pm$ cm. in length..... 1. **Carex feani**

1. *Carex feani*, new species (Pl. XV, B).

Perennial; culms caespitose, $80 \pm$ cm. in height, 3-4 + mm. in diameter, sharply triangular, the faces convex, the angles scabrous: leaves numerous, up to $1 \pm$ meters in length, $7 \pm$ mm. in width, spinulose-serrate along the margin and keel; outer leaves reduced to scalelike basal sheaths 2-3 + cm. long, with loose, fibrous margins; inflorescence composed of 6-7 + cylindrical, long-pedunculate, loosely racemose spikes, single from the axils of long-foliose or subulate clasping bracts; spikes 4-10 + cm. in length, dark-brown, commonly carpellate and $1 \pm$ cm. in diameter, in the basal two-thirds, and staminate in the slender apical third (rarely two-thirds); peduncles slender, compressed, drooping, spinulose serrate along the angles, 1-10 + cm. in length, the basal one longer than the remainder; bracts leaf-like, clasping at the base, the basal one 30-60 + cm. long, the upper ones progressively smaller and ultimately subulate; scale of staminate floret narrowly oblong obovate or elliptical, 5-6 mm. in length, $1 \pm$ mm. in width, mucronate or short-aristate (the awn antrorsely barbed), prominently 1-veined, with a single, less prominent vein near each side; scale of carpellate flower oblong-lanceolate, 4-5 + mm. in length, $1.5 \pm$ mm. in width, mucronate or shortly aristate, rarely retuse, 3-veined, perigynium $5 \pm$ mm. long, compressed, biconvex, membranous, conspicuously many-veined, the apex acute, short, truncate, the mouth subentire; achene dull dark-brown, minutely punctate under a lens, compressed, biconvex, orbicular-obovate in outline, apiculate, 2 mm. in length, 1.5 mm. in width, style 2-parted, with slender stigmatic branches $2 \pm$ mm. long.

Marquesas, Hivaoa, Feani, altitude 800 meters, December, 1921, F. Brown, nos. 1036A and 1036B, type.

It is closely allied to *C. stokesii* of Rapa, and both species are remarkably close to the Andine-Antarctic *C. darwinii* var. γ *urolepis* Kükenthal (25, p.

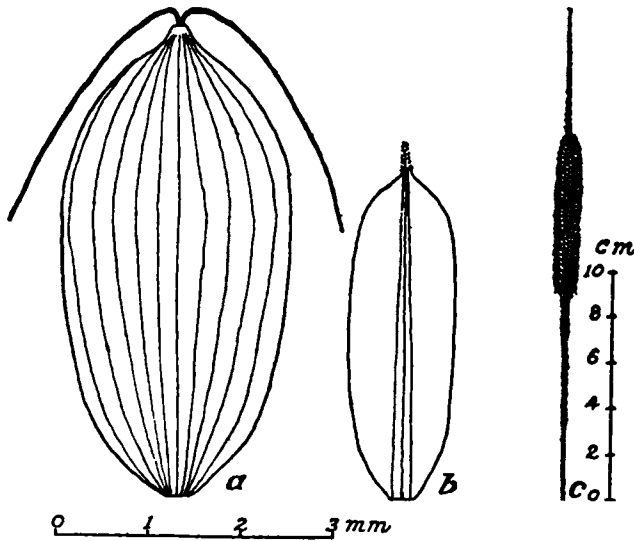


FIGURE 13.—*Carex stokesii*: a, perigynium with style branches exserted from the subentire mouth; b, scalelike glume from carpellate portion of spike; c, spike with empty scales in the basal third portion, carpellate flowers in the central third, and staminate flowers in the slender third portion at the end.

367), which is credited to Patagonia and Chatham Island. Other near allies are (1) *C. subdola* and *C. ternaria* of Stewart Island and high elevations in New Zealand; (2) *C. rechingeri*, altitude 1300 meters, Samoa; *C. sandwicensis*, mountains of Hawaii.

Endemic in the Marquesas; rare; collected only on Feani [Keiani] ridge, Hivaoa.

2. *Carex stokesii*, new species (fig. 13).

Caespitose perennial; culms $1 \pm$ mm. in height, 4-5 mm. in diameter, sharply triangular with convex sides, scabrous or nearly smooth along the angles; leaves numerous, $150 \pm$ cm. in length, $1 \pm$ cm. wide near the base, sharply spinulose-serrate along the margins and the upper and lower surface of the veins; outer leaves reduced to clasping scalelike sheaths 2-3 cm. long, loosely fibrous on the margin; inflorescence composed of $12 \pm$ cylindrical, long pedunculate spikes, each subtended by a long-foliose or subulate bract; spikes 4-20 + cm. long, dark-brown, commonly carpellate for a distance of $5 \pm$ cm. in the central and basal portion which is $1 \pm$ cm. in diameter, with a slender staminate tip $2-6 \pm$ cm. long; in some spikes, with empty scales and slender for a distance of 2-6 cm. in the basal portion; 1 (or more) of the upper terminal and subterminal spikelets staminate throughout; peduncles 1-20 + cm. in length, slender, drooping, compressed, sharply spinulose-serrate along the angles, the basal ones longer than the others; bracts leaf-like, clasping at the base, the basal one up to 120 + cm. in length, the upper ones progressively smaller and ultimately subulate; scale of staminate floret oblong-lanceolate, $5 \pm$ mm. long, $1 \pm$ mm. in width, $1.5 \pm$ mm. broad near the apex, conspicuously 1-veined with a slender 1, or 2 in var. *aristata*, on each side, very shortly mucronate ($0.1 \pm$ mm.), from an obtuse, truncate, or subretuse apex, glabrate, the mucro antrorsely barbed; 3 stamens; scale of carpellate flower lanceolate, $3.5 \pm$ mm. in length, $1.3 \pm$ mm. in width, shortly mucronate ($0.3 \pm$ mm.), or aristate in var. *aristata*, from an obtusely rounded truncate or subretuse apex, commonly 3-veined; perigynium obovate, $5 \pm$ mm. long, conspicuously multiveined, acutely pointed at the apex, the opening subentire or indistinctly bidentate; style with 2 slender branches $1.5 \pm$ mm. long, protruding from the apical opening of the perigynium; achene compressed biconvex, broadly elliptical or obovate in outline, apiculate, $2.5 \pm$ mm. in length, $1.6 \pm$ mm. in width, yellow (to dark-brown).

Rapa, altitude 100 \pm meters, September 21, 1921, Stokes, no. 244A, type. Rapa, Area, September 21, 1921, Stokes, no. 244; Rapa, Nukumaala, Stokes, no. 262; Rapa, Aruhu, altitude 17 \pm meters, December 26, 1921, Stokes, no. 439 (nos. 262 and 439 are immature specimens probably belonging to this species); reference types.

Carex stokesii of Rapa is closely related to *C. feani* of Hivaoa, Marquesas, from which it differs in height, length and width of the leaves, length of the spikes, size of the scales, and the size and shape of the achene. Var. *aristata* connects both species with *C. darwinii* Boott of southern South America and Chatham Island.

The native name is *kiekie* in Rapa, where the strong, flexible leaves take the place of cordage in tying taro and various things into bundles. The leaves of *R(h)ynchospora* doubtless were used in a similar manner; hence the same native name, *kiekie*, was applied to it.

Endemic in Rapa.

2a. *Carex stokesii* var. *aristata*, new variety.

Carpellate scales short ($3 \pm$ mm. long), $1.5 \pm$ mm. in width, commonly acuminate, varying to truncate or retuse at the apex, terminating in an upwardly barbed awn $1-3.5 +$ mm. in length, extending beyond the perigynium, distinctly 3-veined, rarely obscurely 5-veined; perigynium $3 \pm$ mm. long, the mouth apiculate, subentire or obscurely bidentate, biconvex, 20-veined (10-veined \pm on each side); staminate scale elliptical, acute or obtusely rounded at the end, mucronate, $4 \pm$ mm. in length, $1.5 \pm$ mm. in width, 3-5-veined; achene small, $2 \pm$ mm. long, relatively narrow, $1.4 \pm$ mm. in width, dull brownish-black, minutely punctate under a lens.

Rapa, 1922, Quayle no. O, type.

A distinct variety, which connects the species closely with *C. darwinii* Boott var. γ , *urolepis* Kükenthal (25, p. 367) occurring in the southern part of South America and in Chatham Island. Var. *aristata* differs from var. *urolepis* in the spikes, which are borne singly instead of 1-3 from the axils of the bracts; perigynium 10-veined on each side instead of 3-5 veined.

Endemic in Rapa.

FAMILY 4. PALMAE

Shrubs or trees with large palmate or pinnate leaves; inflorescence spadici-form, simple or branched; flowers monosporangiate or bisporangiate; calyx and corolla each of 3 divisions; stamens commonly 6 in number; ovulary 3-merous; fruit 1-3-locular.

More than 1000 species, widely distributed in the tropics and subtropics, centering in America; well represented in the region of the East Indies and Australia; poorly represented in Asia and Africa; a few species widely scattered in Polynesia.

KEY

1. Leaves palmate, petioles unarmed, fruit less than 5 cm. in diameter.....1. **Pritchardia**
1. Leaves pinnately veined or divided (2)
2. Leaves pinnately divided; fruit smooth (3)
2. Leaves entire when young, tearing into irregular pinnate divisions if exposed to the wind; fruit with an uneven surface.....2. **Pelagodoxa**
3. Spadix branched.....3. **Cocos**
3. Spadix simple.....4. **Diplothemium**

I. PRITCHARDIA Seemann and H. Wendland

Trees with palmate leaves; petioles unarmed; inflorescence axillary, paniculate; flowers bisporangiate; calyx 3-dentate; corolla with 3 deciduous divisions; 6 stamens, the filaments united at the base; ovulary with 3 uniovulate locules, only 1 of which matures, forming a 1-seeded drupelike fruit; style trigonal; stigma 3-parted.

A genus of 33 species, most of which are endemic in the Hawaiian islands; 2 species occur in Fiji, one of which, *P. pacifica*, has also a variety in Samoa and another in the Marquesas; 2 species are credited to the Tuamotus; 3 species are of uncertain origin; *P. wrightii*, in the West Indies, is of particular interest in connection with the origin, dispersal, and distribution of the genus. The Coryphea center in America.

1. ***Pritchardia pacifica*** Seemann and Wendland var. ***marquisensis***, new variety (Pl. XXV, A).

Tree 10-17 + meters in height and $30 \pm$ cm. in diameter; lamina of leaves fan-shaped $175 \pm$ cm. in length, $140 \pm$ cm. in width, the base obtusely rounded, the margin divided into $73 \pm$ segments $60 \pm$ cm. deep, each segment 2-parted to a depth of $20 \pm$ cm., the central entire portion of the leaf extending from the base anteriorly to nearly two-thirds of the distance to the margin, both surfaces glabrous when mature and without scales (lepidia) on the under surface except along the veins which are covered with a short cotton-like pubescence; petiole finally glabrous, $105 \pm$ cm. long or nearly 60 per cent of the length of the blade; spadix $70 \pm$ cm. in length, shorter than the petiole, pubescent, branching in the distal half to form a broad panicle with $9 \pm$ simple, flower-bearing branches in the apical portion and $9 \pm$ 4- to 8-parted branches below, the flower-bearing branches 10-20 cm. in length, and 3-4 mm. in diameter at the base; spathes tubular below, boat-shaped above, pubescent; flowers spirally arranged, each subtended by a subulate bract; calyx 3-dentate; corolla composed of 3 triangular obtuse segments; anthers deeply sagittate at the base, prominently notched at the apex; filaments broad and united at the base, tapering to an acute apex, which is attached to the central dorsal surface of the anther; fruit spherical, 10-16 mm. in diameter, dark-brown.

Marquesas, Nukuhiva, western Taipi Vai, Hapaa region, Hakapuu Vai, a small valley, August 19, 1921, F. Brown, nos. 647, A, B, C, type.

Inasmuch as no plants of this species or genus were found outside of areas which were formerly inhabited, it is not unlikely that this palm may have been introduced by the early inhabitants. However it differs in habit and in the size of leaves and fruits from the species as described by Seemann (39, p. 247) or Beccari and Rock (1, p. 29).

The native names are *vahake* in Nukuhiva, *vahana* in the southern Marquesas; in Hawaii the name *hawane* or *wahane* is applied to the fruit. The common English name is fan palm. In the Marquesas the fruits served as food in time of famine; the leaves were used for fine weaving and for making baskets to hold the heads of the dead after they had been mummified. A valuable palm for landscape planting in moist, sheltered situations.

Endemic in the Marquesas, where it is of rare occurrence in inhabited valleys. The typical species occurs in Fiji and is credited to Tonga. A variety also occurs in Samoa. (See Beccari and Rock, 1, p. 30.)

2. **PELAGODOXA** Beccari

Original description by Beccari published by Bois (6); amplified by F. Brown:

"Arbor, trunco 6-8 m. longo, 10-15 cent. diam. Folia amplissima, limbo flabello-oblongo, plicato-pluricostulata, 2-3 m. longo, 1-1.20 m. lato, in margine anteriore argute dentata, supra viridi, subtus albido-argenteo, petiolo 60-80 cent. longo. Spadix racemosus, fructifer circiter 70 cent. longus, interfoliaceus, simpliciter ramosus. Fructus magnus, sphaericus, 10-15 cent. diam., monospermus, pericarpio crasso, conspicue tessellato-verrucoso, verrucis magnis, irregulariter pyramidatis et fissis, nucleo tenuiter lignoso, Semen globosum, erectum, hilo basilari, testa tenui, albumine plane aequabili, intus caro embryo basilaris."

Flowers monosporangiate, grouped in threes, sunk in deep cavities of the floriferous branches, each cluster consisting of a carpellate flower with a staminate flower on each side; fruits spherical with coarse pyramidal projections on the surface, 1-seeded; leaves large, obovate, entire, or torn irregularly into few to many pinnate divisions.

Two species: one collected in the Marquesas and Austral Islands; a second reported from New Caledonia; allied to *Manicaria* of tropical America.

1. *Pelagodoxa henryana* Beccari (Pl. XXVI).

Tree 6 ± meters in height; stems erect, 15 ± cm. in diameter, the surface marked by ring-scars of leaves; leaves crowded at the end of the stem, 15 ±, narrowly obovate, 3.5 ± meters in length, 90 ± cm. in width, parted at the apex forming a v-shaped opening 20-30 + cm. in depth, coarsely dentate in the apical portion, the blade entire when young, but soon shredded by the wind into many irregular pinnate divisions; upper surface glabrous, dark-green; under surface greenish-white, covered with minute scalelike pubescence (lepidia); petiole 70 ± cm. long, covered with white lepidia; inflorescence interfoliaceous; spathe boat-shaped, pubescent, somewhat shorter than the spadix, which is broadly triangular in outline, 50 ± cm. in length, 30 ± cm. in width, pubescent, the basal branches 3-4-partite, the upper ones simple, each subtended by a bract the lowest of which is 16 ± cm. long and spathe-like, the upper bracts progressively smaller to less than 1 cm. in length; flower-bearing branches 20 ± cm. long, 5 ± mm. in diameter; flowers sessile, compactly grouped in threes except near the apex, partly sunk in the spirally arranged cavities of the branch, each group composed of 2 deciduous staminate flowers with a persistent carpellate flower hidden between and beneath them at the bottom of the cavity, the staminate flowers blooming and falling away before the opening of the carpellate flower; apical cavities each containing a single staminate flower; the subapical cavities each contain 3 flowers, but the carpellate flower is commonly vestigial. Staminate flowers: sepals 3, imbricate, convex, suborbicular, 2 ± mm. in height; petals 3, 2 mm. in height, valvate; stamens 6, the ovulary vestigial. Carpellate flower: bibracteate, the bracts conspicuously striate, 2 mm. long, enclosing the unopened flower; sepals 3, 2 mm. long, imbricate; petals 3, valvate, 2 mm. long; stamens vestigial; ovulary subglobose, finally trilobular? becoming unilocular and 1-seeded in fruit; fruits 12 ± in a panicle, globose, 10 ± cm. in diameter (10-15 cm. according to Beccari), the pericarp corky-fibrous, 2 cm. in thickness, irregularly split into coarse pyramidal projections on the outer surface, the endocarp sclerous, rather thin; seed solitary, obscurely polyhedral, covered with a thin brownish testa, the embryo situated at one end; endosperm 2 ± cm. in thickness, rather hard, white; the central cavity small, with a volume equal to nearly one-third that of the albumen, surrounded by a watery pulp.

Type in Paris. Marquesas, Nukuhiva, head of Taipi Vai, near cascade—type locality—August 19, 1921, F. Brown, no. 646. Austral Islands, Raivavae, April 15, 1922, Stokes, No. 60; reference types.

Beccari, who had not seen the flowers, considered *P. henryana* a near ally of *Manicaria saccharifera* Gaertner of tropical America. It is also rather

closely allied to the coconut, and to the nikau palm (*Rhopalostylis*) of New Zealand. It was discovered by M. Henry in 1916 at Taipi Vai, Nukuhiva, and was described the following year by Beccari in form of a footnote in an article by Bois (6).

This exceedingly rare species is apparently indigenous to the Marquesas, where only a small number of trees were observed growing in the type locality, a side ravine at the head of Taipi Vai. According to native informants, there were also a few trees growing at low altitudes in the north-eastern part of Nukuhiva. The single tree growing at Puamau, Hivaoa, was doubtless introduced from Nukuhiva. The same species may also be indigenous to Raivavae, Austral Islands, although some of the native traditions, recorded by Mr. J. F. G. Stokes, vaguely imply that the tree was introduced.

A second species, to which Skottsberg (42) has called attention, is described by Burret in the Berlin Garden Notizblatt from fruits found in New Caledonia.

The native names in the Marquesas are *enu* and *vahane*; in Raivavae, it is *haari rohutu*. The Polynesian name *niu* for coconut, and the Maori name *nikau* for *Rhopalostylis* are somewhat similar to the Marquesan name. Dr. Peter Buck, in a personal communication, says: "In the Cook Islands, the nut of the coconut is *niu* and the leaf in some islands is *nikau*. In New Zealand the name *nikau* was applied to the palm *Rhopalostylis sapida*, probably directly from the leaf *nikau*, as it was the part used in New Zealand for thatching while there was no edible nut. The words *niu*, *ni*, and *nu* are all used in various parts of Polynesia to denote the nut. The word *enu* used in the Marquesas would seem to indicate the use of *nu* from the fact that the nut resembles somewhat the coconut, with the indefinite article *e* (a) prefixed and thus forming *enu*."

In the Marquesas the immature endosperm was sometimes consumed as food, especially in time of famine. However, the endosperm, unlike that of the coconut, becomes hard and inedible when mature. A watery extract from the endosperm was used as medicine.

3. COCOS Linnaeus

Trees with pinnately divided leaves; spadix interfoliaceous, simply branched; flowers monosporangiate, sessile; carpellate flowers at the base of the spadix.

About 60 species centering in tropical America. The probable American origin of the coconut is indicated not only in the concentration of species but also in the grouping of related genera.

1. *Cocos nucifera* Linnaeus (Pl. XXV, B, C).

Tree 4-30 meters in height; leaves subterminal, pinnate; fruits ovoidal to ellipsoidal in shape, 1-seeded, with a thick fibrous pericarp.

The existence of well-defined, apparently endemic botanical varieties or species, such as the one with umbonate fruits shown in figure 13*a*, leads to the conclusion that the coconut was indigenous to the Marquesas. The Marquesans cultivated not less than 50 varieties, each having a native binomial name formed from the general term *ehi*, northern dialect, or *eehi*, southern dialect, followed by a qualifying term indicating the variety. The general term for "coconut" in the Tuamotus was *niu*, as in Niue Island, Hawaii, and many other parts of Polynesia. In the Society Islands it is now *haari*, but in ancient times it was *niu*, according to Nadeaud. In all probability *niu* instead of *ehi*, northern dialect, or *eehi*, southern dialect, was also the ancient Marquesan general term, inasmuch as this word occurs in or forms the root of several binomials now preserved in the northern part of the archipelago; for example, *ehi niu*, and also *ehi niuvaehcu*, a variety cultivated at Hatiehu, Nukuhiva, and on Uapou. The reason for changing the widely known ancient name of certain food plants is not entirely clear. Apparently it was the outcome, in part at least, of long intensive cultivation, during which numerous local varieties were developed, which differed so greatly, as a whole, from those found elsewhere that it seemed best to change the collective name.

The following binomials apply to the varieties of coconut cultivated by the ancient Marquesans. The common English name for all varieties is "coconut"; French, "cocotier."

Ehi anamaimoa—Uapou.
 Eehi apua—Fatuhiva.
 Eehi atiu nui—Fatuhiva.
 Ehi auoi—Northern.
 Ehi fatuau—Northern.
 Eehi hatetea—Hivaoa.
 Ehi hatuau—Nukuhiva; husk hard.
 Ehi hominoe—Uapou.
 Ehi hue—Nukuhiva (husk thin; shell thick with flat bottom, up to 16 cm. in diameter).
 Ehi huetu—Nukuhiva.
 Eehi ipu—Fatuhiva (fruits large).
 Ehi kaha—Northern (husk thick with strong fibrous strands).
 Ehi kata—Northern.
 Ehi kee—Northern (no meat; shell soft).
 Ehi kounui—Northern.
 Eehi keke—Fatuhiva.

Ehi niuvaehcu—Hatiehu, Nukuhiva; Uapou.
 Eehi omotu—Lowlands, Fatuhiva (green, small).
 Ehi ootahi—Nukuhiva. [A remarkable coconut-like palm with spicate inflorescence and fruits sessile on an unbranched central axis. The fruits bear a thick beaklike protuberance at the apex (fig. 13*a*). This variation has been described without name by Henry (19); apparently it belongs to the genus *Diplothemium* instead of *Cocos*.]
 Eehi otepo—Southern.
 Ehi pakanaia—Nukuhiva (epidermis of husk green; sap of nut much sweeter than that of other varieties; used to season foods).
 Ehi pakaratai—Uapou.

- Eehi kivakiva—Taaoa, Hivaoa.
 Eehi kokotahi—Taaoa, Hivaoa.
 Eehi konavi—Northern.
 Eehi kotahi—Hatiehu, Nukuhiva.
 Eehi kotape—Taaoa, Hivaoa.
 Eehi kuakua—Taaoa, Hivaoa.
 Eehi mamaemoa—Nukuhiva (fruits small with conical beaklike protuberance at the end; apparently a distinct botanical variety or species).
 Eehi manao—Hakau, Nukuhiva.
 Eehi ma'oi—Northern.
 Eehi nevehonu—Northern (shell thin, large).
 Eehi niu—Northern.
 Eehi niuoefiti—Northern.
 Eehi niu oae hiti—Northern (same as *fiti*?).
 Eehi niu manao—Northern.
 Eehi panu—Taaoa, Hivaoa.
 Eehi papaa—Fatuhiwa (fruits large).
 Eehi pimata—Northern.
 Eehi puhautea—Fatuhiwa.
 Eehi pukiki—Fatuhiwa.
 Eehi tapatu—Hatiehu, Nukuhiva.
 Eehi tia'a'ei—Northern.
 Eehi tihatiha—Northern (fruits very small).
 Eehi tuaivi—Fatuhiwa.
 Eehi tupu—Fatuhiwa; grows well on highlands (fruits large).
 Eehi uhiau—Taaoa, Hivaoa.
 Eehi veitahi—Nukuhiva (a single elongated fruit on each flower stem).
 Eehi vevetahi—Nukuhiva (fruits isolated, large).
 Eehi vetevete—Uapou.

Although the breadfruit ranked first in importance in the native life of the Marquesas, all parts of the coconut played an important part. With the advent of modern houses and appliances it is not used as extensively as in ancient times, but it still serves many purposes. The use of coconut as a food plant has become more extensive since the recent development of the copra (*puoo*) industry, which has led to the planting of more palms and the neglect and destruction of the breadfruit trees, thus increasing the number of available nuts and decreasing the amount of breadfruit produced.

In the Tuamotu Islands, with their limited agricultural possibilities, the coconut thrives like *Pandanus* spp. (*ha'a*, *fa'a*) on the low coral islands, ranking second only to *Pandanus* in food value. There, on account of the scarcity of fresh drinking water, the invigorating and refreshing sap (*vai'oe*, *vai'oohi*) of the green nut (*ehee vai'oe*, *ehee vai'oohi*) adds to its importance. In ancient times in the Marquesas, doubtless on account of the limited number of coconuts and the large population, they were used as food only on festive or special occasions, except in times of famine. On such occasions the coconut cream (*kao ehi*; *kao eehi*) served either as an ingredient of certain foods made from the breadfruit (*mei*), taro, banana (*mei'a*, *meika*), *fei*, yam, sweet potato, *pia*, and *mape*, or as sauce for *popoi* and fish. At the present time the sauces and relishes known as *miti hue*, *miti ha'ari*, and *taiero*, which are made from the grated flesh of the coconut or its extracted cream, with additional ingredients, and served, especially in the southern Marquesan Islands, with fish or roasted breadfruit, are introduced from Tahiti. Now as in olden times, when no meat, fish, or fruit was available as *ina'i* to eat with the *popoi*, a piece of coconut flesh or endosperm (*kiko*) is substituted; *popoi* is never consumed alone.

Coconut cream (*kao ehi*, *kao eehi*) is obtained from the flesh or endosperm

(*kiko*) of a fully matured ripe nut (*ehi*, *eehi*). The flesh is grated (*ehi heka*, *eehi feka*), then a handful at a time is placed in a sieve (*tauaka*) made either from a mass of shredded stems of *mou'u* (*Cyperus pennatus*), the soft tissues having been washed out leaving only the fibers, which are so arranged that some are longitudinal, others crosswise and diagonal; or from the inner fibers (*huka*) of the coconut husk (*kei kaha*, *rei rava*) picked apart, the fine particles shaken or washed out and the fibers arranged in the same manner. The fibers are gathered up over the grated flesh, and the whole is squeezed (*oo'i*, *oohi*) with the hands. The milky juice (*kao*) extracted by the pressure of the hands passed through the meshes while the particles of flesh are caught in them. In the Cook Islands, according to Buck (10, p. 82), coconut cream was added to some of the dyes used in dying bark cloth (*tapa*).

Steam (*uakako*, *u'ako*) from freshly grated coconut flesh (*kiko*) placed in a medicine receptacle and hot stones added was and still is considered to have a medicinal quality by the native Marquesans.

Usually the watery sap (*vai'oe*, *vai'oohi*) contained in the green nut (*ehi vai'oe*, *eehi vai oo'hi*) at a certain stage in the development is slightly sweet in taste, although Henry (23, p. 43) reports a variety in the Tuamotus in which the sap is salty. Sap from the green nut, especially when it effervesces (*tafa*) is a highly refreshing drink, and frequently takes the place of water on long trips, as it tends to quench thirst better than water. At this stage, the sap is considered also to have a medical quality. The green nut of the *ehi pakanaia* of the Marquesas yields a sap which is sweeter than that of other varieties and is used as formerly to aid in the sweetening of many foods. Likewise it was considered a remedy for heartburn and kidney trouble.

The soft curdlike flesh or endosperm of the immature nut (*oepivai*) was, as now, frequently fed to young babies and young suckling pigs which had been deprived of their natural source of nourishment. The spongy absorbing organ (*titio*, *titupu*) of the germinating embryo (*uto*) in a sprouting coconut (*tupu titio*) is eaten whenever obtained.

An intoxicating beverage (*koko*, *namu*) with a high alcohol content is made by fermenting the sap which is obtained from the unopened inflorescence (*kopu*), by binding it and cutting off the tip. It is claimed by the natives that this custom did not originate with them, but was introduced by a runaway sailor from an European ship. Christian believes it was an Asiatic sea rover instead of a sailor.

Aside from its value as food and commercially as copra, the nuts yield an oil (*kao*) which has always been used in many ways by the Marquesans and other Polynesians. At the present time in the Marquesas, it serves principally as an ointment for the hair and body, or medicinally. It is also

used as a varnish or paint for the woodwork of canoes (*vaka*); calabashes (*kooka*) made of *miro*, *tou*, *tamanu*, and *mei*; and cups (*ipu ehi*, *ipu eehi*) made from empty coconut shells (*ipu*). In ancient times, besides these usages previously mentioned, it served as an embalming fluid for the dead and for waterproofing bark cloth (*tapa*). Doubtless this later custom prevailed throughout Polynesia, as Buck (9, p. 83) refers to its use in this manner in the Cook Islands. He also refers to the addition of this oil to certain dyes.

The present native Marquesan method of extracting the oil from the flesh of the nut is practically the same as that used in ancient times. Coconut cream rich in emulsified oil is exposed to the direct rays of the sun, the heat causing the oil (*kao*) to rise to the surface, where it is gathered as fast as it collects. This is continued until all the oil has been extracted from the thickly curdled mass (*ota*) in the bottom of the container. However, the oil can be obtained in small quantities by a quicker process (*kau ehi*), which consists of placing hot stones in the coconut milk until it curdles and the oil comes to the surface. If an especially fine grade of oil is desired for anointing the head or body, the selected nuts are opened in the morning and left until the following day, when the flesh is grated and the cream extracted. To this is added pieces of fragrant dried plants or leaves. It is then covered and placed in the house for 24 hours. After this period, it is either exposed to the sun or kept in the house; in either case it is stirred twice a day. Two days after the preparation of the first coconut cream, the flesh of one-half of the same number of nuts originally used is grated, the cream extracted and added to the mixture, which is again covered, stirred regularly, and the oil removed as it collects until all of the oil is extracted.

Empty coconut shells were and still are used to some extent by the Marquesans as cups (*ipu*), containers (*putui*) for water or other fluids, and as medicine receptacles for steaming (*ukako*) parts of the body. For these purposes, nuts of certain varieties were selected. The nuts of *ehi hue*, on account of their shape, which resembles a bowl or calabash with a thick, flat bottom, were chosen for the making of cups and water containers; and the long nuts of the variety *ehi veitahi* were selected for the medicine receptacle. The cups were made by cutting off one-third or one-half of the part (*komata*) of the nut containing the germ pits (*mata*) or "eyes." The flesh or endosperm (*kiko*) was removed either by scraping or by weighing down the shell in running water and allowing the fresh water shrimps to remove the contents. Then the edge was smoothed and the outer surface of the shell scraped, covered with coconut oil, and polished. Water containers (*putui*) were made by opening all three of the "eyes," removing the flesh, scraping, covering with coconut oil, and polishing. A cord of sennit is passed through

two of the "eyes" to serve as a handle. The third "eye" (*komata*) is enlarged to serve as an opening.

Two of the long nuts of the *ehi vevetahi* were selected for making the medicine receptacle used in steaming (*ukako*) parts of the body. About one-third or less of the part (*komata*) of the nut containing the "eyes" of two nuts was cut off in such a way that when one was slipped over the other they fit tightly together. A hole was made in the upper one to allow the steam to escape. The kernel was removed and the surface polished or not.

The nuts also served as playthings for the children. Tiny, immature, fallen nuts (*koie*) were spun as tops, while discarded empty halves containing the "eyes" were utilized as "play" shoes. The game consists in balancing one foot on each of the convex ends of the half shell, holding the string, which is passed through two of the "eyes," in the hands taut, while walking. Doubtless the attraction was the clapping noise made. The custom does not seem to have been confined to the children of the Marquesas, as Buck (9, p. 323) records this amusement for the children of Aitutaki, and native informants in Tahiti mentioned this sport as one in which Tahitian children of ancient times indulged.

In ancient times, a piece a coconut shell (*ipu*), sharpened by rubbing the edge on a rough stone lashed to a stick, served as a coconut grater (*ehi heka, eehi feka*). According to native informants, the coconut shell was used in repairing the fractured skull.

While the thick husk was removed (*ako te ehi*) with the teeth, by the native Marquesans, they ordinarily husked the nut by holding it in the hands and striking it slantingly upon the sharp point of a thick stick (*ko, kou*) preferably cut from the *kokou* (*Sapindus microcarpa*), the other end of which had been driven into the ground. The sharp point penetrated the husk and served as a lever to pry it away,

Fibers (*kei kaha*) from the husk of the various varieties differ greatly in length. The husk of *ehi kaha* is over 30 cm. in length and 4 cm. in thickness. The strong flexible fibrous strands from this husk are braided into cordage or sennit (*puu*), which is resistant to rain or sea water. Also, lines (*hii*) used for fishing were made from coconut fibers by laying two or more of the fibers on the thigh and with the palm of the hand rolling them together into a cord.

The leaves (*au poa*) served many purposes, the most important of which was their use as thatch (*opoa*). However, breadfruit leaves were used more extensively than coconut leaves for thatch in ancient times, owing to the large number of leaves necessary and the relative scarcity of palms. In former times, 4,000 coconut leaves were required to thatch the king's house at Hahau, Nukuhiva, the roof of which extended to the ground at the back. For an average house of the newer type, with bamboo sides, 400 leaves were

used. When thatch was needed for a new house or for renewing the roof of an old one, the entire community would come together and plait (*aaka*, *keana*) the thatch. The method of making thatch in the Marquesas differed in Nukuhiva and Hivaoa. In both Nukuhiva and Hivaoa the leaf was separated into two halves by splitting the rachis, beginning at its apex or tip. In Hivaoa, each half of the leaf was plaited separately in check, two leaflets being used to form a single weft. They were then laid together and tied. In Nukuhiva, the two halves were laid together, one-half being reversed so that the butt of each half, which is heavier, thicker, and has longer leaflets, lay against the apical half of the other, which is lighter, thinner, and has shorter leaflets. In this way the leaflets of each half crossed each other in opposite directions. They were then plaited in check, three leaflets being used to form the weft. (See Pl. XXXIII.) This made the thatch much narrower and thicker than that in Hivaoa. The Hivaoa method is used in the Society Islands, and, according to Buck, in the Cook Islands and Samoa. It is said that in the Marquesas coconut thatch will last three years.

Fans and baskets (*kete*) of various sizes and shapes for carrying, storing, or cooking foods, the silo-like structures (*tahoa ma*) for holding fermenting breadfruit preparatory to the making of *ma*, and seines for use in fishing at certain times are still braided from coconut leaves. Also torches made of the twisted dried leaves (*kouoo*) for fishing at night are used at present. But braiding of rough sleeping mats (*tahii*), tapu signs (*koaho*) for storehouses of food, curtains (*tapahii*) for doorways of native houses, and the use of leaflets (*au*) cut from the rachis (*ha*) of a mature leaf (*au poa*) in making the native bed has been practically discontinued.

In ancient times, the rachis of a mature leaf (*au poa*) from which all the leaflets (*au*) but the tip one (*veu ehi*) had been removed, was carried as a sign (*kou ehi*) of welcome or war.

Midribs (*niniku*, *iniku*, *iniu*, *viniku*, *kikinu*, *kiakinu*) of the coconut leaflet were and still are used for many purposes. Fastened together in bundles, they serve as brooms. In ancient times the nuts of *kuku* (*Aleurites moluccana*) were strung on them (*vi kinu*) for lamps (*ama*). In the making of leis, especially for the head, flowers were strung upon them. Leis are still made in this manner in Fatuhiva. Also these midribs (*iniku*) of the leaflet (*au*), when split, serve as in former times for pins to fasten together (*tui te iniku*) the leaves of ti (*Cordyline terminalis*) into bundles (*autima*) for lining the *ma* pits (*ua ma*). Even the old fallen inflorescence (*kopu*) was utilized. It is used even at the present time as a yard broom.

The trunk of the coconut palm was never used in construction of the ancient Marquesan house—only as a front (*puako*) and back (*puako tua*) of the native bed. In the Cook Islands the trunk was sometimes used in

the framework of the native house, according to Buck (9, p. 3). From the wood of the trunk (*tuma aku*) of the palm, 8-prong spears (*kaka ehi*) were made for the purpose of catching the *aku*, a form of swordfish.

The terminal bud (*muko*) of the palm makes a delicious salad (*ihalata*) when shredded. This is a recent custom rarely practised as the taking of it kills the palm.

Copra is now by far the leading commercial product of the Marquesas, and particularly of the Tuamotus, where the highest grade is obtained. To permit the development of this industry the natives of the Marqueses have been forced to sacrifice their groves of breadfruit and plant coconuts, which now predominate in all the inhabited valleys. Six years after planting, the tree may begin to bear and soon yields 40 or more nuts a year. Eighty coconut palms thus yield 3200 nuts a year, from which a ton of copra is obtained. Allowing 100 trees per hectare, Taipi Vai would yield 250 tons of copra a year, which is probably a conservative estimate.

Coconut sennit is also a commercial product. It is made from the fiber of the husk, which has been soaked in sea water, then beaten to separate the nonfibrous tissues from the fibers. Both light and heavy cordage is made by braiding the fibers into 3-ply strands. These are made into packets weighing 950 g. to 1 kg. and containing about 70 meters of cordage. These are exchanged with trading schooners for which an average of 2.50 francs in merchandise is received for each packet. In Europe, the fiber is manufactured into brushes, mats, and cordage.

The area of distribution includes Central America and Polynesia westward to tropical Asia; probably indigenous to the Tuamotus and the Marquesas.

4. DIPLOTHEMIUM Martius (fig. 14).

Shrubs or small trees; leaves pinnately divided, glaucous or white beneath; spadix simple; spathes 2; flowers monosporangiate, dioecious or monoecious, crowded in spirals, bracteate; flowers sessile and staminate near the end of the spadix, carpellate and staminate in the inferior portion; 6 stamens or more; carpellate flowers large or small, the ovulary trigonal-globose; fruit ovoid or obovoid, 1-seeded; pericarp fibrous, with a hard shell-like endocarp bearing three subcircular depressions near the base; endosperm edible; embryo opposite one of the basal depressions.

Five species endemic to Bolivia and Brazil; probably one species from the Marquesas.

In Hakau Valley, Nukuhiva, occur a few specimens of a remarkable palm discovered and described without name by Henry (19). This palm was not in flower at the time of my visit in 1921; hence it cannot be positively classified until additional material is procured. The trunk, pinnatisect leaves,

and crown are very similar to the coconut in size and general appearance, but the thick, unbranched spadix, with crowded, spirally arranged fruit scars and therefore flowers, double spathe, and other characters, appears definitely to separate this palm from *Cocos* and to place it probably in the genus *Diplothemium* (*D. henryanum*, new species?). Henry's description, freely translated, is as follows:

Spadix simple, spicate, 100-120 cm. in length, bearing flowers 80 ± cm. of its length, resembling an enormous ear of corn in appearance; spathes subcylindrical, tardily dehiscent, brownish-green, the surface finely grooved; carpellate flowers large, grouped 2-4 in the distal two-thirds of the spadix, enclosed in 8 broad bracts from which they protrude in flowering, the ovulary sharply trigonal, becoming umbonate at the apex and rounded at the base on fruiting; staminate flowers terminating in the apical 10 cm. of the spadix and grouped in the axils of the carpellate flowers in the remainder of the flowering spadix; fruits few, 2-3+ in each spadix, the others not developing due apparently to the fact that the staminate flowers mature inside the closed spathe, before the carpellate flowers have emerged from the bracts; fruit irregularly ovoidal, obliquely asymmetrical, 16 ± cm. in diameter, 26-28 + cm. in extreme length, terminating in a straight or curved umbonate apex; epidermis yellowish-brown; husk thin; nut 12 ± cm. in diameter, 14 ± cm. in length, obliquely ovoidal, terminating in a slender beak 9 ± cm. in length, and bearing 3 subcircular depressions near the base; endosperm not abundant.

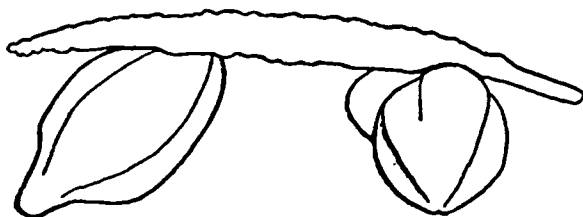


FIGURE 14.—Native variety of coconut with fruits sessile on an unbranched spadix; native name, *ehi ootahi*, in Nukuhiva (*Diplothemium henryanum*).

This species is evidently close to *D. caudescens* from the mountainous regions of South America. It is used by the natives for the same purposes as the coconut.

Endemic in the Marquesas. The native name in Nukuhiva is *ehi ootahi* (unbranched flower stem).

FAMILY 5. ARACEAE

Herbs; flowers monosporangiate, rarely bisporangiate, closely crowded in a spadix.

A large family in the Tropics. All six genera occurring in the Marquesas, with the exception of *Xanthosoma*, are natives of Asia or Malaysia and are probably of ancient aboriginal introduction in the Marquesas.

KEY

- | | | |
|---|----|-----------------------|
| 1. Leaves peltate..... | 3. | Colocasia |
| 1. Leaves not peltate (2) | | |
| 2. Leaves divided..... | 2. | Amorphophallus |
| 2. Leaves entire or subentire (3) | | |
| 3. Leaves without distinct intramarginal vein (4) | | |
| 3. Leaves with distinct intramarginal vein (5) | | |
| 4. Basal lobes acute..... | 1. | Cyrtosperma |
| 4. Basal lobes obtuse..... | 4. | Alocasia |
| 5. Intramarginal vein $5 \pm$ mm. from margin..... | 5. | Xanthosoma |
| 5. Intramarginal vein $10 \pm$ mm. from margin..... | 6. | Typhonium |

I. CYRTOSPERMA Griffith

Inflorescence a densely flowered cylindrical spadix, greatly exceeded by the spadix in length; flowers bisporangiate; 4-6 stamens; ovulary unilocular, containing 1 or more ovules; plants of robust habit, the stem commonly a subterranean rhizome or tuber, never erect; petiole cylindrical, armed with spines, rarely smooth; lamina of leaves hastate-sagittate, the anterior lobe commonly subequal to the posterior lobes in length, or irregularly incised in American species.

About 11 species, of which 2 occur in Brazil, 2 in Africa, the remainder in the East Indies and Melanesia.

1. **Cyrtosperma merkusii** (Hasskarl) Schott (Pl. XVI, A).

"Robusta, aculeis rectis. Laminae fol. sagittato-hastata, costis posticis angulo recto divergentibus, apice simpliciter excurrentibus. Spatha hians, oblonga, extus hyacintha, nervis sulfureis. Spadix sessilis."—Schott (37, p. 126).

Acaulescent perennial herb, with a short, thick, branched rhizome or corm; petiole 4-25 \pm dm. in length, up to 1 dm. in diameter, armed with short, straight spines; lamina of leaves sagittate-hastate to ovate-hastate, obtuse or subacute, variable especially in the juvenile stages, up to 150 + cm. in length and 80 + cm. in width, the anterior lobe 1-7 dm., the posterior lobes commonly slightly longer, rarely equal or shorter, acute or subacute; veins prominent, with 1 primary vein to each lobe, the 2 basal ones diverging at an angle of 90 \pm degrees (65-110 + degrees) free from the blade at the apex of the sinus for a distance of 3 \pm cm.; sinus commonly relatively broad and shallow in juvenile leaves, open to narrow in adults; secondary veins terminating and reticulately branched in the thickened margin of the blade, without intramarginal veins.

Marquesas, Nukuhiva, June 6, 1921, F. Brown, no. 417, reference type.

No flowers or fruit, but the leaf characters are in accord with the description of Schott as well as Engler's interpretation (16, p. 20), indicating that the Marquesan representative may be a form of *C. merkusii*. The native home of this species is Java, which is also the home of the breadfruit, the leading food plant of the Marquesans. Assuming that *C. merkusii* has been under long cultivation as a food plant by the early Polynesians, it is to be expected that a number of cultural forms would occur.

Cyrtosperma edule of Engler (16, p. 17), including *C. chamissonis* of Merrill, with disagreement between description and illustration of leaf-shape, is confusing. The Marquesan specimen is different in leaf-shape from either the description or the illustration. This species and the numerous synonyms cited may represent only the cultivated forms of the early Polynesians, as follows:

KEY

- | | |
|---|----------------|
| 1. Basal lobes of mature leaf shorter than the anterior lobe..... | Tahitian form |
| 1. Basal lobes of mature leaf longer than the anterior one (2) | |
| 2. Basal lobes slightly longer (3) | |
| 2. Basal lobes much longer | Radak form |
| 3. Petiole smooth | Fijian form |
| 3. Petiole spinescent | Marquesan form |

Tahitian form (New Guinea eastward to the Society Islands).

Cyrtosperma edule Engler.

Cyrtosperma chamissonis Merrill.

Cyrtosperma merkusii var. *gigantea* Nadeaud.

Petiole up to 35 dm. in length, smooth or minutely spinescent in the lower portion; blades up to 1 meter long, hastate or ovate-hastate, the basal lobes, when mature, shorter than the anterior one (longer in Engler, 16, fig. 6), subequal when young; basal costae divergent, forming an angle of nearly 180 degrees.

Radak form (Radak Islands)

Arisaenotis chamissonis Schott (37, p. 129).

Cyrtosperma chamissonis Merrill, in part.

Petiole ?; leaf blades hastate, the basal lobes much longer than the anterior one, widely diverging at the sinus; posterior costae with 3-5 branches.

Fijian form (Fiji).

Cyrtosperma edulis Schott.

Petioles $4 \pm$ dm. long, smooth; blades hastate, small, $4 \pm$ dm. long; basal lobes, when mature, somewhat longer than the anterior one, subequal when young, posterior costae diverging, forming an angle of nearly 180 degrees. (See Schott, 37, p. 367.)

Marquesan form (Marquesas).

Petiole up to 25 + dm. in length, spinescent; leaf-blade hastate or ovate-hastate, up to 130 cm. long; lobes, when mature, subequal or the posterior ones slightly shorter; posterior lobes longer than the anterior one when young; posterior costae diverging at an angle of 60-90 + degrees.

The native names are *ta'o kape tao-tao* in the Marquesas; *maota* in Tahiti, *opeves* in Raiatea; *via kana* in Fiji; and *pulaa* in Samoa.

The preparation and use of this plant as food by the natives was similar to taro (*Colocasia antiquorum*). However, it was considered inferior on

account of the lower starch content of the numerous small corms from the branched rhizome. The outer tissue of the long petiole is fibrous and may be peeled off in ribbon-like strips, which are highly valued in fine grades of mat-weaving.

The plant is rare in the Marquesas at the present time, although well known to the old inhabitants throughout the islands. It would seem that in ancient Marquesan times it was cultivated extensively notwithstanding the fact that at the time of discovery by Europeans there was little in cultivation.

A native of Java, of aboriginal introduction in the Marquesas and probably in other parts of Polynesia.

2. AMORPHOPHALLUS Blume

Inflorescence a spadix, the staminate portion shorter than the carpellate; spathe broadly ovate, subcampanulate; flowers monosporangiate; 1-6 stamens; ovulary subglobose or obovoid, composed of 1-4-ovulate locules; stigma entire or 2-4-lobed; berry 1- to several-seeded; leaf blade irregularly incised.

The tubers of all species rich in starch; edible when cooked. About 30 ± species, chiefly from the East Indies, a few from the Philippines, tropical Asia, and Africa.

1. *Amorphophallus campanulatus* (Roxburg) Blume.

Acaulescent herb, perennial from a subterranean corm; leaves 1 or 2, 50-100 cm. in height, the blade 3-9 + dm. in length and width, trisected to the base, the divisions once or twice branched dichotomously, the ultimate segments oblong or lanceolate-oblong, acuminate, unequal, decurrent on the primary costae except near the junction of the petiole; petiole cylindrical, fleshy, the surface green spotted with pale yellowish-green, rough to subsperescent, rugose; peduncle 5-10 + cm. in length, 3 + cm. in diameter, greatly elongated in fruiting; spathe convolute, subcampanulate, 20 ± cm. in length, 25 ± cm. in width, fleshy near the base, thin and spreading above, the margin undulate, green, spotted with deep-purple within, the surface with wartlike protuberances; carpellate portion of spadix subcylindrical, 5-7 cm. in length, deep-purple; staminate portion obconical, 3-5 cm. in length, 2 cm. in diameter at the base, enlarging to 4-5 cm. above; sterile terminal portion domelike in shape, 7-12 cm. in length and diameter.

Marquesas, Nukuhiva, Hakau Valley, June 16, 1921, F. Brown, no. 455, reference type.

The laminae of the leaves resemble those of the *pia* (*Tacca pinnatifida*), from which they differ in thickness, less prominent veins, and the presence of a distinct intramarginal vein 2-5 mm. from the margin.

The native names are *teve* in the Marquesas and Tahiti, *daga* in Samoa and Fiji, and *mahee* in Malaysia. The corms are said to be edible when cooked but are rarely if ever prepared for food by the present Marquesans. The acrid juice forms one of the constituents of the native medicines.

Native of tropical Asia; probably of ancient aboriginal introduction in the Marquesas, where it is naturalized and of occasional occurrence in all inhabited valleys.

3. COLOCASIA Schott

Flowers monosporangiate, the staminate flowers in the upper portion of the spadix, the carpellate below, contained in the persistent tubular portion of the spathe; 3-6 united stamens; ovulary unilocular, containing several locules; petioles sheathing below; leaf-blades with thickened margins, without prominent intramarginal veins, cordate or cordate-peltate, the basal lobes rounded; stem forming a corm or rhizome, or erect.

About 7 species in tropical Asia and Malaysia.

1. *Colocasia antiquorum* Schott var. *esculenta* (Linnaeus) Schott (Pl. XVI, B; XXVII; Fig. 15).

Perennial, acaulescent herb $1 \pm$ meters in height, forming tubers of high starch content; petioles smooth, cylindrical, sheathing at the base; leaf-blade cordate-peltate, acute, 20-50+ cm. in length, the basal lobes rounded; margin thickened; intramarginal vein close to the margin (1-2 mm.), not prominent; peduncle shorter than the petiole; spathe yellowish white or red, 15-35 cm. in length, the lower portion thickened and rolled into a persistent tube.

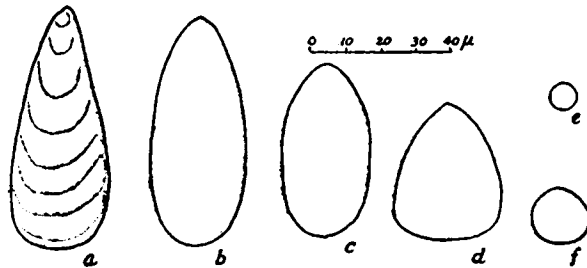


FIGURE 15.—Shape and size of starch granules of Marquesan food plants: *a*, striated granule of rhizome of *Curcuma longa*; *b*, aerial tuber of *Dioscorea alata*; *c*, subterranean tuber of *Dioscorea cayenensis* (?); *d*, aerial tuber of *Dioscorea bulbifera*; *e*, rhizome of *Colocasia antiquorum*; *f*, fruit of *Artocarpus incisa*.

Undoubtedly taro ranked next to the breadfruit as one of the leading food plants of the ancient Marquesans. The corms appear to have a higher starch content than any other of the aroids cultivated in the native agriculture. According to native informants in Nukuhiva, many of the improved varieties of taro, together with the practice of its use in making of poi and other dishes, were introduced by Tueni, a Hawaiian who came ashore in the valley of Hakaui from a burning ship, bringing Hawaiian taro with him. It is true that the ancient varieties, which are extremely acrid and require long baking in the native oven, are not cultivated or used to

any extent. At the present time, preference is given to the improved, less acrid, and rapid-cooking varieties. Doubtless the more extensive use of taro at the present time in making *popoi*, *ka'aku*, *poki*, and similar dishes, which in ancient times were made chiefly with breadfruit, is due to the scarcity of breadfruit owing to the sacrifice of the breadfruit trees in the extensive cultivation of coconuts to supply the copra trade.

While the Marquesans used the young taro leaves for food, the present custom of baking young taro leaves with coconut cream was introduced from Tahiti, where it is a favorite food to eat with squid. In ancient native agriculture, even the slopes of hillsides were terraced to form taro beds, the water of interior streams being utilized for irrigation. At the present time, most of them have been abandoned, the taro patches now used being located lower in the valleys near dwellings.

The area to be used in cultivation of taro is divided into compartments (*kaepu ta'o*) by low walls leading from a higher to a lower level. These are flooded with shallow water. The plants are propagated by separating young shoots from old plants and planting them in shallow water. With some of the improved varieties, the corms grow in three months to the size of a large orange and may be used for food. In six to nine months some tubers are $40 \pm$ cm. in length with a diameter of $15 \pm$ cm. Flowers or fruit rarely appear, and these occur only on old plants. The ancient Marquesans cultivated the following thirty varieties of taro, all of which are grown in shallow water:

Ta'o autoto.—Plant $1 \pm$ meters tall; leaf blades $50 \pm$ cm. long; petiole red, corm $25 \pm$ cm. in length; 15 cm. in diam.; Nukuhiva; extinct.

Ta'o eva.—Hivaoa and Uapou; said to have been originated by the Marquesans.

Ta'o faa faa.—Fatuhiva; Marquesan product.

Ta'o haneaoo.—Aquatic herb $1 \pm$ meters high, with spotted, peltate leaves; petiole variegated yellow and green, becoming clear-yellow near the blade; flower white; corms large, $35 \pm$ cm. long, 22 cm. in diameter, with white flesh; quickly cooked; also called *tao hanieoo*; a Marquesan product, according to native tradition. Nukuhiva, Hakaui, June 12, 1921, no. 610; July 28, 1921, no. 557; F. Brown, reference types.

Ta'o kaiama.—Tubers slightly reddish, of fine texture; flowers white; considered one of the best varieties; now extinct; of Marquesan origin.

Ta'o koa koa.—Hivaoa; of Marquesan origin.

Ta'o kofau.—Fatuhiva; of Marquesan origin.

Ta'o kohihina.—Fatuhiva; of Marquesan origin.

Ta'o kohahuinui.—Hivaoa; of Marquesan origin.

Ta'o kopuaakoa.—Hivaoa; of Marquesan origin.

Ta'o kua.—Hivaoa; of Marquesan origin.

Ta'o lehu.—Fatuhiva; the presence of *l* in a Marquesan plant name very rarely occurs; it was recorded only from Fatuhiva.

Ta'o makatea.—Nukuhiva; excellent for roasting over fire; corms reddish, similar to those of *ta'o kaiama*; flowers white. The name *makatea* suggests introduction from Makatea, western Tuamotus.

Ta'o malua.—Fatuhiva; name of interest from the presence of the letter *l* in the name.

Ta'o ma'oi.—Nukuhiva. $1 \pm$ meters in height; flowers white; tubers, which are very

acid, are not considered good when cooked by boiling in water, but require long baking in the native oven before the acid principle is removed. This variety, which occurs throughout the Marquesas, is considered the most ancient of all. It is very hardy, having escaped from native cultivation and become naturalized along streams up to altitudes of 1,000 ± meters. According to native informants, this is the kind from which all other varieties were produced through native cultivation and selection. Marquesas, Nukuhiva, Hakau Valley, cultivated, June 12, 1921, F. Brown, no. 611; Nukuhiva, naturalized along streams, altitude 800 ± meters, July 20, 1921, F. Brown, no. 510; reference types. (See Pl. XXVII, C.)

Ta'o maraua.—Rather small, 60 ± cm. in height; leaves cordate-peltate; petioles red; flowers white; corms small, 15 ± cm. long, 12 ± cm. in diameter, with white interior; Marquesan product. Nukuhiva, Hakau, June 12, 1921, F. Brown, no. 612, reference type. Ta'o mohi.—Plant 1 ± meters in height; leaves cordate-peltate; petioles reddish; flowers red; corms large, 60 cm. long, 20 cm. in diameter, with white interior, which remains light in color when cooked; requires long cooking (1-2 hours); Nukuhiva, Uapou; of Marquesan origin.

Ta'o nehu.—Hivaoa; Marquesan product.

Ta'o poitele.—Fatuhiva; the occurrence of *l* in the name is of interest; evidently the same as *poitere* of the northern dialect and in part of Fatuhiva.

Ta'o poitere.—Of medium height (50-80 cm.); leaves dark-green above, with red at the base of the veins; petiole reddish in the upper portion; flowers red; corms rather small with dark outer tissues and light-colored interior. A variety of ancient introduction from Hawaii, or, according to some natives, from Tahiti; considered an excellent variety; cooks quickly; Nukuhiva, Uapou, Hivaoa, Fatuhiva. Nukuhiva, Hakau, July 28, 1921, F. Brown, no. 556, reference type. (See Pl. XXVII, A.)

Ta'o poki (poni in Hatiehu, Nukuhiva).—Plant 1 ± meters in height; petioles deep-purple; flowers red; corms small. Said to be a Marquesan product; Nukuhiva, Uapou; used in native medicine, not as food; Nukuhiva, Hakau, July 28, 1921, F. Brown, no. 561, reference type.

Ta'o poni.—Hatiehu, Nukuhiva; Marquesan product (same as *poki*?).

Ta'o puhauehine.—Fatuhiva.

Ta'o rapa.—Plant 1 ± meters in height, leaves cordate-peltate; petiole red, striped with deep-green or red; veins reddish; corms with white flesh. Said to have been introduced in ancient times from Rapa; best method of cooking is baking in native oven, but not boiling in water. Nukuhiva, Hakau, F. Brown, no. 560 reference type. (See Pl. XXVII, D.)

Ta'o rehu.—Plant 1.7 ± mm. in height; leaves cordate-peltate; petioles reddish near base but green above; veins reddish; flowers red; corms large, 60 cm. by 20 cm., the interior light-blue when cooked. A favorite variety, either for roasting in the native oven or boiling in water; cooks quickly (10-20 minutes); widely cultivated in the Marquesas; said to have been brought from Hawaii. Nukuhiva, July 28, 1921, F. Brown, no. 558, reference type.

Ta'o ta' faa.—Hivaoa.

Ta'o tea.—Fatuhiva.

Ta'o to'ake.—Marquesas.

Ta'o tonao.—Fatuhiva.

Ta'o uea.—Fatuhiva.

It is of interest to observe that Henry (20, p. 35) lists 36 cultivated or wild varieties cultivated or grown by the Tahitians and that only one of these (*poitere*) can be identified with those grown by the Marquesans.

Native of India. The native names are *ta'o* in the Marquesas; *talo* in Samoa; taro in Hawaii, Tahiti, Cook Islands, and New Zealand. Taro, with

variation according to dialect, is the prevailing general name throughout Polynesia. The common English name is taro.

4. ALOCASIA Schott

The representatives occurring in the Marquesas are caulescent herbs with cordate leaves. About 60 species in tropical Asia, Malaysia, and the Philippines.

1. *Alocasia macrorrhiza* (Linnaeus) Schott (Pl. XVI, C).

Tall, caulescent herb, the stem thick, 10-15 + cm. in diameter, rarely over 2 meters in height in the Marquesas; lamina of leaves cordate, 80 ± cm. long, 50 ± cm. wide, acute, with an obtuse basal sinus in which each of the basal costae are nearly free for a distance of 5 ± cm.; marginal veins close to and scarcely distinct from the thickened margin of the blade, without prominent intramarginal vein; ultimate branches of the lateral veins subparallel at their junction with the marginal thickening; petioles 120 ± cm. long, cylindrical above, sheathing below, smooth; spathe thickened at the base and rolled into a persistent closed tube 5 ± cm. in length, the upper open portion thin, pale-yellow, 20 ± cm. long, deciduous; flowers monosporangiate, the carpellate flowers in the lower portion of the spadix, the staminate ones above; peduncles 15-20 cm. in length.

According to Engler and Krause, the stem reaches a diameter of 20-30 cm. and a height of 5 meters.

Three varieties were distinguished by the Marquesans: '*ape koha* and '*ape kua* in Fatuhiva; and '*kape ma'oi* (northern dialect) or '*ape ma'oi* (southern dialect). The '*kape ma'oi* is characterized by a stem 1-2 meters in height, 5-10 cm. in diameter; lamina of leaves glabrous, of firm texture, cordate-hastate, up to 1 + meters in length, deep-green; petiole smooth, glabrous, faintly mottled with purplish-green. This native variety was cultivated throughout the Marquesas, where it was considered the most ancient of all varieties and the one from which the other varieties were developed through native methods of cultivation.

Nukuhiva, Hakau, June 22, 1921, F. Brown, no. 426; June 10, 1921, F. Brown, no. 786; reference types.

According to Henry (20, p. 36), the Tahitians recognized 5 varieties, the names of all of which are different from the Marquesan ones above cited.

The native names are '*kape* (northern dialect), '*ape* (southern dialect), in the Marquesas; '*ape* in Hawaii and Tahiti; '*taa mu* in Samoa. The common English name is giant taro. The leaves of the '*kape* are highly esteemed by the natives for wrapping certain kinds of packages. Also they were used as bathtubs for babies; the stems were baked for food in time of famine. The plant is used in landscape gardening for its tropical foliage.

Native of Ceylon and India; introduced in Pacific islands by the early Polynesians. In the Marquesas it is common and apparently naturalized throughout the archipelago.

5. XANTHOSOMA (Schott) Engler

Caulесcent or аcaulescent herbs; leaf blade cordate-hastate or divided. About 20 species in tropical America and the West Indies.

1. *Xanthosoma atrovirens* C. Koch and Bouché (Pl. XVI, D).

Acaulescent; stem cormlike; blade of leaves sagittate-cordate, 70-80 cm. long, 60 ± cm. wide, cuspidate, the basal lobes obtuse; surface deep-green above, light-green below; intramarginal veins present, one 5 ± mm. from the margin, the second 1 ± mm.; petiole 30-60 ± cm. long, deep-green, obscurely striated, smooth, cylindrical above, sheathing below.

As reference types have no flowers or fruit, identification is not positive.

The native names are *tarua* in the Marquesas and Tahiti. The common English name is dry-land taro.

The corms are rich in starch and proteids and are prepared for food in the same way as the taro, *Colocasia antiquorum*. The plant does not require standing water for growth, being cultivated on moist, rich land.

Indigenous to tropical America; cultivated in the West Indies and in the tropics of the Old World; introduced and cultivated in parts of Polynesia. The few plants under cultivation in the Marquesas appear to have been brought at a late period from Tahiti by the natives.

6. TYPHONIUM Schott

Flowers monosporangiate, naked; staminate portion of spadix separated at some distance from the carpellate portion; 1-3 stamens; ovulary unilocular, 1-2-ovulate; stigma sessile, hemispherical; lamina of leaves sagittate-hastate or 3-5-lobed, 3-parted or divided; 3 marginal veins, the third at some distance from the margin.

About 17 species in tropical and temperate Asia, East Indies, and Australia.

1. *Typhonium trilobatum* (Linnaeus) Schott (Pl. XVI, E).

Petiole 30 ± cm. long, tuberculate; lamina hastately lobed, the median lobe 10-20 + cm. in length, 10-15 + cm. in width, acuminate; lateral lobes 18 ± cm. long, ovate, subacute, the lower margin abruptly contracted at the base, forming an obtuse sinus in which the 2 lower costae are free for a distance of 4 ± cm. at the axil; inner marginal vein distinct, sinuate, 5 to 15 + mm. within the margin; middle vein 2 ± mm. within the margin, nearly parallel with the outline of the blade.

Marquesas, Nukuhiva, Taipi Vai, December, 1921, F. Brown, no. 1135, reference type. No flowers or fruit; identification tentative, based on a single leaf.

The native name is *kape taa taa* in Nukuhiva. The corm, which is 4 ± cm. in diameter, may have served as food.

The area of distribution includes India and Malaysia; of probable ancient aboriginal introduction in the Marquesas.

FAMILY 6. BROMELIACEAE

Herbs, commonly growing as epiphytes or on rocks; rarely terrestrial; leaves commonly crowded in the form of a rosette; inflorescence terminal; flowers bisporangiate; perianth 6-merous, 2-cyclic; 6 stamens, 2-cyclic; ovulary commonly inferior, trilocular, many ovulate; style with 3 contorted stigmatic branches.

According to Mez, 997 species; natives of tropical and subtropical America.

I. ANANAS Adanson

Herbs; leaves crowded in a rosette, linear, spinose-serrate; flowers bisporangiate, sessile, red or violet; petals free, convolute, dextrose; 6 stamens; ovulary inferior, trilocular; fruits forming a cone-shaped syncarpium crowned by a rosette of bracts or leaves. A single species, endemic in Brazil. (See Mez, 31, p. 164.)

1. *Ananas sativus* Schultes (Pl. XXIX, B).

The varieties cultivated by the ancient Marquesans are characterized by long, creeping, terrestrial or aerial stems which branch, vary irregularly in diameter from 2-5 cm., and grow to a height of over 3 meters, clinging to bare rock surfaces by means of aerial roots; leaves crowded near the ends of the branches, linear, 1 ± meters in length, 5 ± cm. broad, more or less spinulose-serrate; inflorescence strobiform, supported on a stalk 25 ± cm. in length and 15 ± mm. in diameter; fruits spirally arranged, fleshy, loosely fused into a cone-shaped syncarpium, which is crowned by a rosette of spirally arranged leaves.

The fruit, which is small in comparison with that of commercial varieties, is extremely fragrant and superior in flavor. The following 6 named and cultivated varieties, all of which were an integral part of the ancient material culture, were evidently originated by the Marquesans from the single Brazilian species. This fact seems fairly positive evidence that the early Polynesians, through contact with America, obtained their original stock long before the discovery of the Marquesas by Europeans.

Haa hoka inana.—Fruit yellow, very fragrant; leaves 1 meter long and 5 cm. broad. The fruit was used for raw food and for leis (*hei*). The leaves supplied a fiber from which the strongest fishlines were made. Present on Nukuhiva; doubtless also on other islands of the Marquesas.

Haa hoka ma'oi.—The fruit served for food and for leis. The leaves, which are 1 meter long and 3-6 cm. wide, furnished a fiber of superior quality for fishlines. This variety is regarded as the most ancient of all and the one from which all other varieties were derived by native cultivation.

Haa hoka meie.—Fruit greenish, $20 \pm$ cm. in length, very fragrant, used for food and for leis; leaves 1 meter in length, 5 cm. wide.

Haa hoka *toa koe*.—Fruit fragrant, used particularly for leis and for scenting coconut oil; fishlines also made from the leaves. Nukuhiva.

Faa hoka inata.—Fruit reddish, used chiefly for food; Hivaoa. May be the same as *haa hoka inana* of Nukuhiva.

Faa hoka kouo.—Fruit green before it is ripe, yellow when ripe, extremely fragrant, highly esteemed for leis and for scenting coconut oil. Southern islands.

Faa hoka mata.—Fruit dull-red when green, red when ripe, valued for leis. Southern islands.

The pineapple was valued in ancient times for its fruits and leaves, the fruits being used more extensively for the leis and for scenting coconut oil than for food. However, the various varieties, thriving as they did on the dry interior uplands, were planted along the trails where no streams or springs existed and few or no coconuts thrived. Thus they afforded food and a refreshing source of thirst-quickening juice. For the making of leis, the "eyes," known as *puka haa hoka* (northern dialect) and *puka faa hoka* (southern dialect), were removed from the syncarpium and strung to form leis. When dried, they retain their fragrance for many months. To scent coconut oil, "eyes" were placed in the oil and allowed to remain for several days. The leaves supplied a strong fiber highly valued for fishlines or delicate weaving. To separate the fiber from the other tissues, the leaves, weighted with stones, were placed in muddy water for four days. By this time, the small amount of tissue left could be scraped from the fibers with the hand. Two or three of these were laid together on the front of the thigh and rolled together with the palm of the hand until they were twisted as a cord; valued especially for fishlines. The pineapple is not now cultivated on a commercial scale in the Marquesas, although in Nukuhiva and other Marquesan islands there is considerable land which seems suitable for this purpose. The native names are *haa hoka* (northern dialect) and *faa hoka* (southern dialect) in the Marquesas; *hara* in the Cook Islands; *ananas* in Brazil and France. The common English name is pineapple.

A native of tropical America, it is evidently of ancient aboriginal introduction in the Marquesas, where it is to be found in all inhabited valleys. A few plants occur here and there at low altitudes, but it seems to have been planted more commonly in the arid uplands in situations too dry and exposed for other plants belonging to the native agriculture. One of the largest pineapple plantations in the Marquesas is in eastern Fatuhiva, on the dry, rocky, exposed slopes of Mouna Natahu, at an altitude of $900 \pm$ meters. The xerophytic trees and shrubs originally covering this mountain have been removed. Under such conditions, the pineapple of the Marquesans grows luxuriantly without cultivation of any kind. The long, tangled stems cover the rocks and stones, where few other plants can grow. A few plants

occur also along the dry trails, but are absent from undisturbed areas of indigenous vegetation.

FAMILY 7. COMMELINACEAE

Herbs; leaves alternate, parallel veined, sheathing at the base; perianth composed of 2 cycles of 3 lobes or segments each, the outer calyx-like; the inner petal-like, commonly more or less irregular; 6 stamens or fewer; style single; ovulary superior 3-2-locular; fruit a capsule.

KEY

- 1. Fertile stamens 3, corolla blue.....1. **Commelina**
- 1. Fertile stamens 6 (2)
- 2. Corolla purple.....2. **Zebrina**
- 2. Corolla white.....3. **Rheo**

I. COMMELINA Linnaeus

Herbs; leaves ovate, lanceolate, or linear, sheathing at the base; inflorescence cymose, axillary, the peduncle bifurcated, bearing a spathe-like bract enclosing the inflorescence; perianth irregular; 3 fertile stamens; 3 staminodia; ovulary trilocular; fruit a 2-3-locular capsule.

About 100 species, widely distributed in the tropics.

1. **Commelina nudiflora** Linnaeus.

Herbaceous; stems weak, prostrate, creeping, ascending to a height of 30 ± cm., covering areas of nearly pure growth or intermixed with associated species; blade of leaves lanceolate, acute, 4 ± cm. long, 1 ± cm. broad, subglabrous, entire, contracted into a ciliate sheathing petiole 1 ± cm. in length; peduncles axillary from the upper leaves, filiform, 1 ± cm. long, bearing a cordate, spathe-like ciliate bract, bifurcate, 1 branch exerted, 1-flowered, 15 ± mm. in length; the second branch short, included, bearing 3 flowers; 3 petals 3 ± mm. long, blue 1 subsessile, 2 contracted into claws.

Marquesas, Nukuhiva, May 27, 1921, F. Brown, no. 391, reference type.

The native names are *hei otona* in the Marquesas; *ma'u'u toga* in Samoa. The common English name is wandering Jew. As the native name indicates, it is sometimes used for leis. It is good forage.

Pantropic; probably of early introduction in the Marquesas, where it is common in all inhabited valleys up to an altitude of 800 + meters.

2. **ZEBRINA** Schnizlein

Two species, in Mexico and Texas.

1. **Zebrina pendula** Linnaeus.

Herbaceous, resembling *Commelina nudiflora* in habit, but the cyme included in the bract; corolla tubular, 3-lobed; 6 stamens, all fertile; leaves striped longitudinally with green and silver.

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Marquesas, Nukuhiva, Taiohae, March 20, 1921, F. Brown, no. 1145, reference type.

The native name is *mutie* in the Marquesas; the common English name, wandering Jew.

Cultivated as an ornamental pot plant, it grows luxuriantly. A garden plant of recent introduction in the Marquesas.

3. RHEO Hance

A single species; native of tropical America.

1. *Rheo discolor* Hance.

Erect herb 30 ± cm. in height; stem thick, creeping; leaves narrowly lanceolate, acute, 20-30 + cm. long, deep-purple below, striped longitudinally above; flowers white, numerous, inclosed in the spathe-like bract; 3 petals; 6 stamens; ovulary 3-locular; locules uniovulate.

Marquesas, Nukuhiva, Taiohae, May 30, 1921, F. Brown, no. 952, reference type.

Of recent introduction; cultivated as an ornamental garden plant throughout the Marquesas; in some places escaped from cultivation and semi-naturalized.

FAMILY 8. LILIACEAE

Herbs; rarely woody plants; perianth of 6 divisions or lobes, 2-cyclic; stamens 6, hypogynous, free or united with the perianth; ovulary superior, commonly trilobular; fruit fleshy or dry.

A large family, widely distributed, but best represented in temperate and subtropical climates; only 2 indigenous species in the Marquesas. (See *Dianella* and *Astelia*.)

KEY

- | | |
|--|-----------------------|
| 1. Woody plants..... | 2. Cordyline |
| 1. Herbs (2) | |
| 2. Perianth tubular..... | 1. Sansevieria |
| 2. Perianth spreading (3) | |
| 3. Style thick, short; segments of perianth connate at base..... | 3. Astelia |
| 3. Style subfiliform; segments of perianth free to the base..... | 4. Dianella |

I. SANSEVIERIA Thunberg (*Sansevieria*)

Flowers bisporangiate, tubular; 6 perianth segments; 6 stamens. About 10 species, natives of the Old World.

1. *Sansevieria zeylanica* Willdenow.

Perennial; leaves sword-shaped, concave, all arising from the base of the stem, 50-60 ± cm. in length, 3 ± cm. wide, thick transversely variegated with light and dark

green; flowers greenish-white, fragrant, pedicellate, racemose in clusters of 3-5 in a single scape which exceeds the leaves in length; perianth tubular, $2 \pm$ cm. long, split to half its length in 6 linear, recurved lobes; stamens and style exserted; fruit globose, light-red, with a thin fleshy pericarp, $8 \pm$ mm. in diameter, containing, as a rule, a single globular seed $6 \pm$ mm. in diameter.

Marquesas, Hivaoa, Atuona, December 8, 1921, F. Brown, no. 848, reference type.

An Old World plant of recent introduction in the Marquesas. One of the largest landscape plantings of this species is to be seen along the dry seaward ledge at the side of the broad trail leading from the harbor to the village of Atuona, Hivaoa, altitude 100 meters; in this situation the plants grow luxuriantly without cultivation. They were in bloom and in fruit on December 8, 1921, the flowers being extremely fragrant at evening when the odor is carried far inland by the sea breeze.

2. CORDYLINE Commers

Woody plants with leaves crowded at the ends of the branches; inflorescence paniculate, terminal; flowers bisporangiate; perianth of 6 divisions; 6 stamens; fruit a trilocular berry with one or more seeds in each locule.

About 12 species, natives of tropical Asia, Malaysia, Australia, New Zealand, and Indo-Malaya, Africa, and Brazil.

1. *Cordyline terminalis* Kunth (Pls. XXX, XXXI).

Description amended by F. Brown to cover Marquesan varieties:

Tree 1-5 meters in height; stem $2-20 +$ cm. (to $70 +$ cm.) in diameter breast high; lamina of leaves elliptical-oblongate in outline, acute, $30-70 +$ cm. in length, $8-20 +$ cm. in width, glabrous, the mature blades with $150-400 +$ parallel veins in the broadest portion, the base contracted into a margined petiole $5-30 +$ cm. long; panicle $30-60$ cm. long, on a peduncle $25 \pm$ cm. long, the branches $6-30$ cm. long, with leaf-like bracts at the base; flowers sessile or subsessile, $9-12$ mm. long, the perianth divided to the middle into six 3-veined lobes, white or purple; bractlets 3, small, triangular, $1-6 +$ mm. long, obtuse or acute; stamens and style as long as the perianth; anthers versatile; wood yellowish-white, rather soft.

The leaf, stem, and panicle measurements of Marquesan specimens greatly exceed those given by other authors; for example, Hillebrand (22, p. 442) for Hawaii. However, Hillebrand's measurements, very likely, apply only to small specimens; living plants occur with leaves as large as those in the Marquesas. There seems to be no reason to believe that the ti cultivated by the Hawaiians is specifically different from that of the Marquesans, although the cultural varieties are not the same.

The native names are *ti* in the Marquesas, Hawaii, Society Islands, Samoa, Cook Islands, Raivavae, Rimatara, and New Zealand; *karokaro* in Rapa, where *ti* and *rauti*, introduced names from Tahiti, are also sometimes

applied to it; and *qui* in Fiji. The leaves were called *auti* by the Marquesans and inasmuch as they cultivated the plant chiefly for the leaves the term *auti*, rather than *ti* was more commonly used in referring to the plant.

Native varieties were cultivated in the various groups of islands. Henry (24, p. 36) lists 13 species that were cultivated in Tahiti; Cheeseman (11, p. 300) states that several varieties were cultivated in olden times in Rarotonga; and Setchell (40, p. 107) describes briefly 6 varieties from Samoa.

The Marquesans cultivated not less than 6 varieties as follows:

KEY TO LIVING MATERIAL

- | | |
|---|-------------------------------|
| 1. Leaves green (2) | |
| 1. Leaves variegated or tinged with red (4) | |
| 2. Leaves conspicuously cup-shaped at the apex..... | 2. Auti kopa |
| | 3. Auti popoi |
| 2. Leaves nearly flat or only slightly cup-shaped at the apex (3) | |
| 3. Leaves narrowly oblanceolate..... | 4. Auti puhehe |
| 3. Leaves broadly oblanceolate..... | 1. Auti ma'oi |
| 4. Leaves not variegated..... | 5. Auti kua (Fatuhiva) |
| 4. Leaves variegated..... | 6. Auti kua (Nukuhiva) |

The following tabulation brings out the characteristic differences preserved in dry herbarium specimens of these varieties.

Maximum width (centimeters)	Number of veins in widest portion	Number of veins per centimeter	Variety
6.6	154	23	kua (Nukuhiva)
9.4	267	28	kua (Fatuhiva)
15.0	293	19	ma'oi
15.0	293	19	puhehe
15.5	315	20	popoi (a)
17.0	369	21	popoi (b)
20.0	400	20	kopa

1. **Auti ma'oi.**

A variety of medium size, 3-5 meters in height, 5-30 cm. in diameter; leaves rather large, the blade oblanceolate, deep-green, acute, flat or somewhat cupped at the apex, up to 55 + cm. in length and 15 + cm. in width, with 293 ± parallel veins in the broadest portion, tapering gradually into a petiole 20 ± cm. long; not observed in flower.

Hivaoa, December 25, 1921, F. Brown, no. 876, reference type. Occasionally found in inhabited valleys throughout the Marquesas.

2. **Auti kopa.**

Tree 2-5 + meters in height; lamina of leaves broadly oblanceolate, up to 70 + cm. in length and 20 + cm. in width, with 400 ± parallel veins in the broadest part, deeply cupped at the apex, acute, tapering into a margined petiole 20-30 cm. in length; panicle large, 60 cm. in length, with branches 5-50 cm. long; flowers subsessile, 10-12 mm. in length, white tinged with purple, the bractlets at the base large, 1-6 + mm. in length, obtuse or acute.

Nukuhiva, Taipi Vai, June 27, 1922, F. Brown, no. 1125, reference type. Frequent in Taipi Vai, Nukuhiva.

The leaves of this variety were preferred for the interior lining of pits where the *ma* (fermented breadfruit) was stored; also used for wrapping large packages of food; the roots grow to large diameter, containing an abundant supply of sugar. (See Pl. XXX, A.)

3. **Auti popoi.**

Somewhat similar to *kopa*, the leaves being less deeply cupped at the apex and more oblanceolate in outline, $17 \pm$ cm. broad, with $369 \pm$ parallel veins in the broadest part. (See Pl. XXXI, A.)

Nukuhiva, Hakau, September 15, 1921, F. Brown, no. 644, reference type. Common in Hakau Valley, Nukuhiva.

4. **Auti puhehe.**

Tree 2-5 + meters in height; leaf blade up to 70 + cm. in length and $15 \pm$ cm. in width, with $293 \pm$ veins in the broadest part, acute, flat or slightly cupped at the apex, tapering at the base into a margined petiole 15-20 cm. long; panicle large, 60 \pm cm. long with branches up to 35 + cm. long; flowers white or slightly tinged with purple, 10-12 mm. long, the bractlets at the base small, triangular, acute, 1-2 mm. long. (See Pl. XXX, B.)

Nukuhiva, Taipi Vai, June 27, 1922, F. Brown, no. 1126, reference type. Frequent in Taipi Valley, Nukuhiva.

A very distinct variety, distinguished by the deep-green, narrowly oblanceolate leaves, which are flat or only slightly cupped at the ends. The secondary veins of the leaves are strong, numerous, and closely spaced, $28 \pm$ per centimeter, which gives the blades of this variety superior longitudinal strength. Therefore it is considered one of the best for strengthening the inner lining of the pits in which *ma* is stored.

5. **Auti kua (Fatuhivan form).**

Tree 3-5 + meters in height, 10-30 cm. (up to 60 cm., according to native informants) in diameter breast high; blade of leaves up to 70 + cm. in length, $9.4 \pm$ cm. in width, with $267 \pm$ parallel veins in the broadest portion, tapering gradually into a margined petiole $23 \pm$ cm. long; panicle large, 60 \pm cm. long, with branches up to 35 + cm. long; flowers white, with a distinct purplish tinge 12 \pm mm. long, subsessile, the bractlets at the base small, 2-4 + mm. long, acute or acuminate, greenish-purple.

Fatuhiva, Omoa, January 20, 1922, F. Brown, no. 883, reference type. Abundant in the upper part of Omoa Valley, Fatuhiva, in a secluded *fei* plantation at an altitude of 400 \pm meters.

Two entirely distinct forms of *auti kua* (red ti) occur in the Marquesas. The Fatuhivan form is readily distinguished by the fact that the leaves, which are narrowly oblanceolate in outline and deep-green in color, tinged with red, are not variegated. This variety was considered sacred in ancient times, as the leaves were made into leis (*hei*) and worn on festive occasions and in connection with ceremonial rites. Even at the present time it is one of the most prized varieties on the island of Fatuhiva, although the leaves

are used for the inner lining of *ma* pits and for wrapping food. The roots, which grow to large diameter, yield an abundance of sugar for food or fermented drink and are eaten when baked. This variety would make an excellent plant for landscape gardening.

6. *Auti kua* (Nukuhivan form).

A relatively small shrub or tree 2-3 meters in height, $3 \pm$ cm. in diameter breast high; blades slightly oblanceolate, acuminate, 30-40 cm. long, $66 \pm$ cm. wide, with $154 \pm$ parallel veins in the widest portion, tapering gradually into a margined petiole 10-13 cm. in length; panicle $40 \pm$ cm. in length with branches of 5-25 cm. in length; flowers $9 \pm$ mm. in length; perianth deep-purple in bud, purple-veined when in flower; bractlets small, $2 \pm$ mm. in length, acute. (See Pl. XXXI, B.)

Nukuhiva, Taiohae, September 1, 1921, F. Brown, no. 599, reference type. Of occasional occurrence in all inhabited valleys near ancient habitations of Nukuhiva, and in yards of European colonists. Probably of recent introduction.

The Nukuhivan form of *auti kua* is readily distinguished from the Fatuhivan form by the relatively small size of the plant and by the comparatively small oblanceolate leaves, which are variegated with longitudinal stripes of red, green, and yellowish-white. A watery extract from the living tissues was used as a native medicine. The leaves are used chiefly for *heis*. It is cultivated as an ornamental foliage plant.

Ti, as it is universally known throughout Polynesia, seems to have been cultivated in the Marquesas as elsewhere in Polynesia, for its leaves, although the roots of some varieties yield considerable food which was of special value in times of scarcity. While the leaves were used frequently in ornamentation by dancers at feasts, they were valued chiefly as wrappers of food when stored, in transportation, or cooking. Due to their freedom from odors of any kind or poisonous sap, and their resistance to the acidity of fermented breadfruit, they are preferred for wrapping fish, meat, *ma* or any food of which *ma* is an ingredient, and for use as an inner lining of the *ma* pits. Anatomically they were well adapted for this purpose. The secondary veins of the blade, which branch from the midvein and curve obliquely upward toward the apex of the leaf, are about the thickness of medium cotton sewing thread. Also, they are strong, flexible, arranged parallel, and as closely spaced as the strands of fine cheese cloth (19-28 per centimeter). In fact, no other plant furnishes leaves combining all the qualities of size, shape, texture, strength, durability, and chemical composition necessary for wrapping food and, particularly, for lining the *ma* pits. The *ma* pit is first lined with banana leaves; then shingle-shaped bundles (*autima*) ingeniously made of ti leaves, are placed in several layers overlapping vertically on the sides and horizontally on the bottom and top of the pit. This forms an inner lining which, when under pressure and the chemical action of the acidic *ma*, possesses the

transverse and longitudinal firmness of a woven fabric and remains in good condition for three years.

These shingle-shaped bundles (*autima*) of ti leaves are made as follows: full-grown leaves are carefully selected, the petioles removed, and the blades sorted into pairs of equal length. The pairs are then arranged in groups of equal numbers—6 in Hatiehu, Nukuhiva, and 8 in Hakau, Nukuhiva—so that the apical portion of one leaf blade or pair of blades is superimposed over the basal portion of the one or the pair beneath. Thus the secondary veins of the superimposed leaves cross those of the leaves beneath. They are fastened into position with sharp pins made from the split midribs of the coconut leaflet.

Leis (*hei*) are made from the leaves by shredding them parallel to the secondary veins and tying them together, to form either a crown for the head or drape over the shoulder. In a similar manner they are made into a skirt and fastened around the waist. For this purpose, old leaves, having turned a bright chrome-yellow, are preferred and are very artistic in contrast with the color of the body.

The wearing of the ti leaves as leis or skirts doubtless was a custom which prevailed throughout Polynesia. Henry (20, p. 37) states that in Tahiti, "the long glossy leaves of green and brilliant-yellow were worn by orators and warriors and enchanters in their official capacities"; Buck (9, pp. 85-87) notes the custom of its use as a skirt in Cook Islands and quotes from Turner: "It was the only garment that either sex thought necessary during the day." Setchell (40, p. 107) mentions the *titi*, or native girdle of the leaves worn in Samoa; and in field notes from Rapa the late Mrs. A. M. Stokes lists under the many uses of the plant that of clothing. Likewise the custom was prevalent in Hawaii.

Narrow ti leaves or shredded blades of the leaves were often braided to give firmness and body to the other types of leis. The *Pandanus* lei was made by tying the keys (drupes) of the fruit aggregate, either singly or in groups, with shredded ti leaf blades.

The roots, which in some varieties grow to large size, yield sugar and in ancient times were baked for a long time in the native oven and eaten. Their use as food is not confined to the Marquesas but is common throughout Polynesia. Henry (20, p. 37) mentions it for Tahiti, Cheeseman (11, p. 300) for Rarotonga, Setchell (40, p. 107) for Samoa, and the late Mrs. A. M. Stokes for Rapa and the Austral Islands. In Rapa it was frequently mixed with the taro in making poi to sweeten it and was also boiled, the liquid strained to make a form of tea or syrup. Doubtless this latter is a more modern custom.

An intoxicating drink was made from the fermented baked ti root in the Marquesas. It is claimed by Henry (20, p. 37) that the making of

distilled liquor (*okolehao*) in Tahiti did not originate with the natives but was taught them by a Hawaiian. That may be true also in the Marquesas.

An Indo-Malayan plant of ancient aboriginal introduction in the Marquesas; excellent for landscape gardening.

3. *ASTELIA* Banks and Solander

Perennials; leaves linear to linear-lanceolate, attached at the basal portion of the stem. Inflorescence racemose-paniculate; flowers monosporangiate or bisporangiate, polygamo-dioecious; perianth of 6 biseriate divisions; stamens of the same number as the perianth segments, at the base of which they are inserted; style short; stigma entire or 3-lobed; fruit a trilocular berry; seeds black.

About 15 species; best represented in New Zealand (6); 1 species in Australia and Tasmania; 1 in Antarctic America; high altitudes in Polynesia.

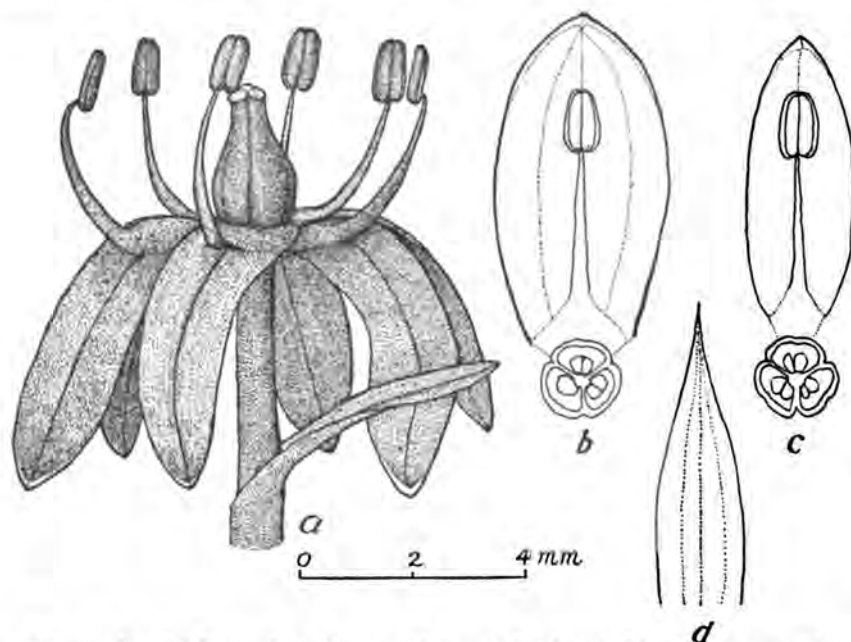


FIGURE 16.—*Astelia tovii*: *a*, flower with bract of typical length but exceptionally blunt; *b*, outer perianth segment of exceptional width; *c*, inner perianth segment of average size and shape; *d*, bract from base of pedicel showing average shape and size.

1. *Astelia tovii*, new species (fig. 16).

Perennial 1 ± meter in height; leaves clasping the base of the stem, linear-lanceolate, 1 ± meters in length, 3 ± cm. in width, attenuate to an acute apex, 3-veined; surface silvery-tomentose, particularly on the under surface, woolly at the base, varying to subglabrous; panicle shorter than the leaves, 30 ± cm. long, pubescent or subglabrous, with

6 ± primary branches up to 15 + cm. in length, simple or the lower ones branched; branches of the panicle each subtended by a leaf-like bract, the one at the base of the lower branch 25 ± cm. in length, longer than the branch, the successive bracts progressively smaller to less than 2 cm. in the ultimate branches; peduncle leafless, 40 ± cm. long, tomentose; flowers polygamo-dioecious, apparently bisporangiate in type, closely racemose on the branches, one, rarely more, from a common base; pedicels 5-6 mm. in length, pubescent or glabrate, subtended by an acuminate-lanceolate 3-veined bracteole of approximately the same length as the pedicel; perianth segments commonly 6 in number, biseriate, greenish-white (?) becoming dark-brown on drying, valvate, recurved in flowering, oblong ovate, acute, 6 ± mm. in length from the center of the axis to the apex of the segment, the outer three 2-3 mm. wide, the inner three 1.8 ± mm. broad, glabrous, subglabrous, or the outer three slightly pubescent on the outer surface, rather thin, 1-veined or faintly 3-veined, connate at the base for a distance of 1 ± mm. from the center of the axis; stamens of the same number as, opposite to, and shorter than the perianth segments, to which they are adnate for a distance of 1.5 ± mm. from the center of the axis; filaments 2.4 ± mm. in length, upwardly curved in flowering, rather stout, 0.1 ± mm. in diameter at the tip, 0.24 ± mm. at the base, glabrous; anthers versatile, attached near the base of the back, broadly elliptical, or ovate-elliptical in outline, 1 ± mm. in length, dehiscent at the sides; ovulary ovate, 3-furrowed, trilocular, 2.2 ± mm. in length, 1.3 ± mm. in diameter; style short but distinct; stigma 3-lobed; fruit unknown.

Marquesas, Nukuhiva, August, 1922?, Quayle, no. 1234, type.

Closely related to the slightly more primitive *Astelia veratroides* of Hawaii, from which it is readily distinguished by the relatively glabrous inflorescence, the less crowded arrangement of the flowers on the branches of the panicle, and the short bracteole at the base of the pedicel. The prominently 3-veined leaves and subglabrous outer covering distinguishes this species from *Astelia nadeaudi* of Tahiti.

Endemic in the Marquesas; infrequent.

4. DIANELLA Lamarck

Perennial; leaves linear, sheathing at the base; inflorescence terminal, racemose, paniculate; flowers bisporangiate; perianth segments (tepals) 6, biseriate, free to the base; style filiform, stigma terminal; fruit a trilocular berry containing one or more black, shining seeds in each locule.

About 12 species very widely scattered in the southern hemisphere, best represented in New Guinea (9) and Australia (5); occurring also in Asia, New Zealand, Norfolk Island, New Caledonia, the high altitudes of Polynesia, tropical America, tropical Africa, and the Mascarene Islands.

The genus forms with *Stypandra* of Australia and *Eccremis* of South America a closely allied group connecting Australia and Polynesia with the Andine region of South America. The fleshy berries, containing small seeds protected by a thick hard outer covering, seem remarkably adapted for seed dispersal by frugivorous birds (see Engler 16, p. 39); yet dispersal by this means has evidently occurred only over short distances. For example, not a single species is common between Australia and New Zealand, and

only one species has crossed the Wallace line to the north of New Guinea. *Dianella intermedia* of the Marquesas has one variety in common with the Society Islands, but this may be accounted for on the supposition that the Tuamotus were at one time high islands and served to bridge the intervening distance within the flight of frugivorous birds. It is of special interest to find a form in the Marquesas almost identical with *Dianella sandwicensis* of Hawaii. This is in accord with other facts of plant distribution, indicating the presence of former high islands along the submerged ridge in the region of the equatorial islands.

The species and varieties in Polynesia are not sharply defined owing perhaps to the fact that some of the characters, such as the venation of the tepals, seem subject to a certain amount of somatic variation, not being perfectly constant even in the same individual. Probably considerable amount of interisland dispersal has occurred within comparatively recent geological times.

The representatives from the Marquesas, Henderson Island, Society Islands, Austral Islands, Norfolk Island, and New Zealand appear to be only poorly defined varieties of *Dianella intermedia*, with the most primitive forms in the region of the Marquesas, and becoming progressively more specialized in the island groups to the west—the probable direction of migration of the species. The 3-5-veined flower of the New Zealand type could be derived from the relatively larger, generalized 5-7-veined flower of the Marquesas. The reverse process is unlikely, hence the characters of the species have been amended to allow for this interpretation.

KEY

- | | |
|--|-------------------------------------|
| 1. Leaves spinulose-serrate along the margin and keel.....1. | <i>Dianella intermedia</i> |
| 1. Leaves smooth (2) | |
| 2. Inner tepals commonly 5-veined.....2. | <i>Dianella odorata</i> |
| 2. Inner tepals commonly 3-veined.....3. | <i>Dianella sandwicensis</i> |

1. *Dianella intermedia* Endlicher.

Description of characters amended by F. Brown:

Perennial 30-120 cm. in height; rhizome rather woody, creeping, branched; leaves from the lower part of the stem, sheathlike, distichous; blades linear, 30-100 cm. in length, 10-25 mm. in width, acute, coriaceous, more or less convolute, the margin and keel minutely spinulose serrate; panicle 18-60 + cm. long, the pedicels commonly less than 2 cm. long, nodding; flowers small to medium in size; tepals 5-7 + mm. long, the outer series oval, acute, greenish or lilac, 5-7 veined, the inner series commonly somewhat broader, 3-5 veined, with a broad white hyaline border; 6 stamens; filaments commonly shorter than the anther, enlarged in the upper portion, nearly as broad as the anther; anther oblong, acutely pointed, with terminal dehiscence, 1.5-2 + mm. in length; berry broadly ellipsoidal, 8-18 mm. long, blue; seeds ovoidal, subacutely pointed, obtuse or truncate at the base, somewhat compressed, 3-4 + mm. in length, 1.5 to 2 + mm. in width, black; pericarp very hard, 0.15 ± mm. in thickness; endosperm abundant, oily.

The native name in Nukuhiva, Marquesas, is *kie kie maha*, where in ancient times the green leaves were used to tie the hands of prisoners taken in war on the old battle grounds of Tovii. Known as *maupo* in Tahiti; *pui* in Rarotonga.

Marquesas, Mangareva, westward to New Zealand and Norfolk Island.

KEY

- 1. Tepals 5-7 + veined.....1. var. **marquisensis**
 - 1. Tepals 3-5 + veined (2)
 - 2. Tepals plainly punctate under a lens.....2. var. **punctata**
 - 2. Tepals not plainly punctate (3)
 - 3. Inner tepals commonly 3-veined (4)
 - 3. Inner tepals commonly 5-veined.....3. var. **gambierensis**
 - 4. Inner tepals decidedly broader than the outer ones, with a hyaline border wider than the central veined portion; seed commonly 4 ± mm. in length.
 - 4. var. **nukuhivensis**
 - 4. Inner tepals somewhat broader than the inner ones; seed commonly 3-3.5 mm. in length.....var. **norfolkensis** (Brown, 7)
1. **Dianella intermedia** Endlicher var. **marquisensis**, new variety (fig. 17, c).

Leaves 30-100 cm. in length, 9-25 mm. in width, minutely spinulose-serrate along the margin and keel; tepals 6.5 ± mm. in length, the outer series 5-7-veined, lilac in color, not distinctly punctate; the inner series broader than the outer ones, with a broad hyaline border, white or tinged with lilac, not distinctly punctate, commonly 5-veined; filaments commonly shorter than the anthers, the enlarged tip nearly as broad as the anther.

Marquesas, Nukuhiva, altitude 900 ± meters, 1922 (?), Quayle, no. 1216, type. Occasional at high altitudes in the Marquesas.

2. **Dianella intermedia** Endlicher var. **punctata**, new variety (fig. 17, a).

Leaves 30-70 cm. in length, 10-20 mm. in width, the margin minutely spinulose-serrate to smooth; outer segments of perianth 5-7 mm. in length, conspicuously punctate under a lens with reddish dots, lilac in color; inner segments (tepals) as long as and as broad as or broader than the outer ones, with or without punctate markings, 3-veined, white or tinged with lilac; seed ovoid-elliptical, subacute, obtuse at the base, somewhat compressed, 4.5 ± mm. in length, 2.5 ± mm. in width.

Rapa, June 6, 1921, Stokes no. 7, type.

The reference types with notes are as follows:

1. Rapa, Morongota, altitude 250 meters, July 15, 1921, Stokes, no. 61.

Leaves 50 ± cm. in length, 11 ± mm. in width, obscurely spinulose-serrulate to smooth on the margin and keel; panicle 40 cm. in height; flowers of medium size, the tepals 6 mm. long, the outer series 5-veined, faintly punctate, lilac in color; inner tepals 6 ± mm. in length 3-veined, with a broad hyaline border, nearly white.

2. Austral Islands, Raivavae, April 17, 1922, Stokes, no. 66.

Leaves 70 ± cm. in length, 15 ± mm. in width, obscurely serrulate to smooth along the margin and keel; panicle shorter than the leaves; flowers large; outer tepals 7 mm.

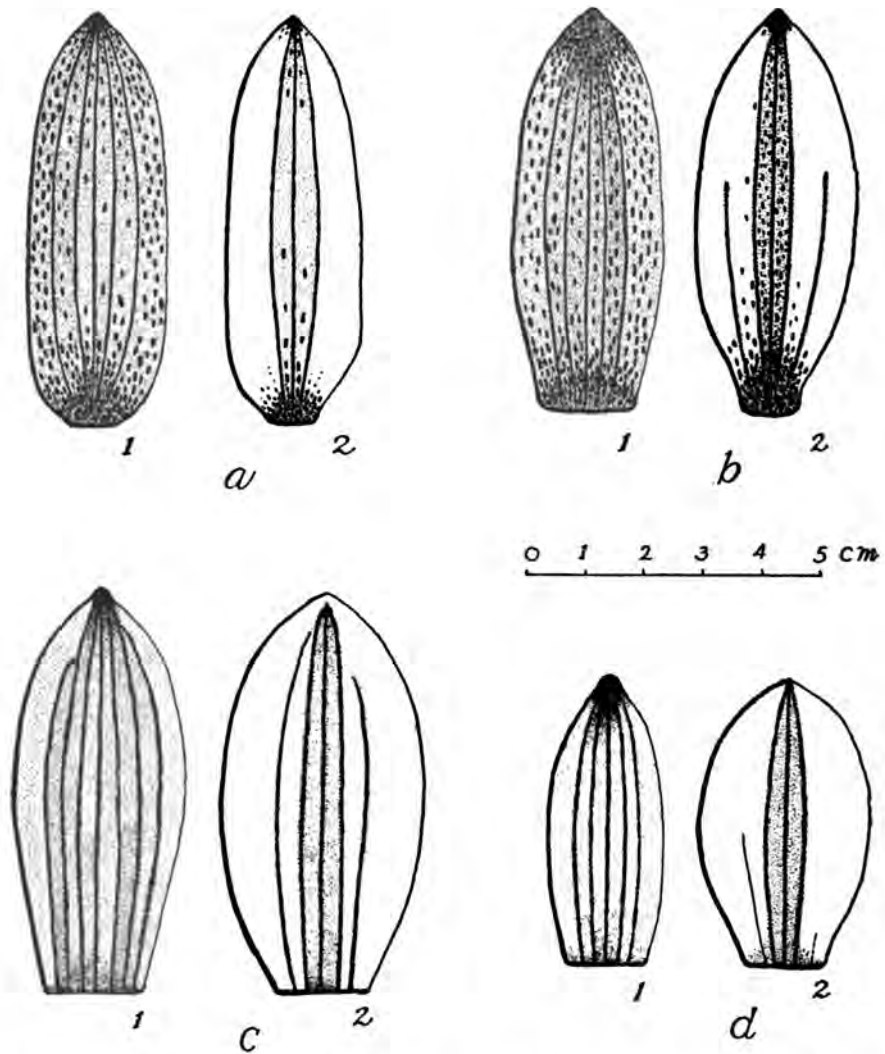


FIGURE 17.—*Dianella intermedia*: a, var. *punctata*, three-veined form (no. 231, Rapa): 1, five-veined outer tepal; 2, three-veined inner tepal; b, var. *punctata*, imperfectly five-veined form (no. 66, Raivavae): 1, five-veined outer tepal; 2, imperfectly five-veined inner tepal; c, var. *marquisensis* (no. 1216, Nukuhiva): 1, seven-veined outer tepal; 2, five-veined inner tepal; d, var. *nukuhivensis* (no. 273, Nukuhiva): 1, five-veined outer tepal; 2, three-veined inner tepal.

long, 5-veined, conspicuously punctate, lilac in color; inner tepals 7 mm. in length, imperfectly 5-veined, punctate in the center, with a broad hyaline (rarely punctate) border, white or pale-lilac.

3. Austral Islands, Rurutu, altitude $150 \pm$ meters, February 17, 1921, Stokes, no. 120.

Leaves 60 cm. in length, $19 \pm$ mm. in width, minutely spinulose-serrate; no flowers or fruit.

4. Rapa, Teakuale, altitude $75 \pm$ meters, September 17, 1921, Stokes, no. 201.

Leaves $30 \pm$ cm. in length, $11 \pm$ mm. wide, minutely spinulose-serrate at the tip, nearly smooth below; panicle longer than the leaves; flowers small; tepals 5 mm. long, the outer ones 5-veined, punctate, lilac in color; inner tepals 3-veined with a broad hyaline border, white tinged with lilac (?).

5. Rapa, Lauea Peak, altitude 400 meters, September 23, 1921, Stokes, no. 231.

Leaves $50 \pm$ cm. long, $20 \pm$ mm. in width, minutely spinulose-serrate to smooth; panicle shorter than the leaves; flowers large; tepals $7 \pm$ mm. long, the outer series 5-veined, conspicuously punctate under a lens; inner tepals 3-veined, with a wide hyaline border.

6. Rapa, Taunoa, near sea level, September 26, 1921, Stokes, no. 274.

Leaves $40 \pm$ cm. in length, 11 mm. in width, minutely spinulose-serrate to smooth along the margin and keel; flowers small; tepals 5 mm. in length, the outer ones 5-veined, conspicuously punctate; inner tepals 3-veined, punctate throughout. A distinct form with punctate inner tepals.

7. Rapa, Taunoa, near shore, January 13, 1922, Stokes, no. 456.

Leaves $40 \pm$ cm. in length, $11 \pm$ mm. in width, obscurely spinulose-serrate to smooth; panicle rather shorter than the leaves; flower of medium size; tepals $6 \pm$ mm. in length, the outer ones 5-veined, conspicuously punctate; inner tepals 3-veined with a broad hyaline border.

8. Austral Islands, Raivavae, 1921, Quayle, no. 292.

Leaves 70 cm. in length, 11 mm. in width, spinulose-serrate along the margin and keel; flowers of medium size; tepals 6 mm. long.

9. Rapa, 1921, Quayle, no. 326.

Leaves 70 cm. long, spinulose-serrate along the margin and keel; panicle shorter than the leaves; flowers small; tepals 5 mm. long, the outer ones 5-veined, punctate, the inner ones 3-veined, with a broad hyaline border; seed elliptical-oval, somewhat compressed, subacute, obtusely rounded at the base, 4.5 mm. long, $2.5 \pm$ mm. wide.

10. Nukuhiva, Taiohae, altitude $900 \pm$ meters, June, 1922, F. Brown, no. 1145.

Perennial 130 cm. in height; leaves $70 \pm$ cm. in length, $20 \pm$ mm. in width, coriaceous, minutely spinulose-serrate along the margin and keel, especially near the apex; panicle longer than the leaves, 1.30 + cm. in height including the peduncle, the floriferous portion $60 \pm$ cm. in length; flowers large, the outer tepals $6 \pm$ mm. long, 5-veined, conspicuously punctate under a lens, lilac; inner tepals $6 \pm$ mm. long, as broad as the outer ones, 3-veined, with a broad hyaline border, more or less punctate throughout; anthers $3 \pm$ mm. long; filaments $3 \pm$ mm. long; seeds $4.5 \pm$ mm. long, $2.5 \pm$ mm. in width, jet-black. A fairly distinct variety characterized by its punctate 5-veined outer tepals and 3-veined inner tepals.

The native names are *oio* in Rurutu and *hio* in Rapa. Area of distribution includes the Austral Islands, Rapa, and the Marquesas.

3. *Dianella intermedia* Endlicher var. *gambierensis*, new variety.

Leaves $45 \pm$ cm. in length, $18 \pm$ in width, minutely spinulose-serrate to smooth along margin and keel; panicle longer than the leaves; flowers small; outer tepals 5 mm. in length (in bud) both series faintly punctate and 5-veined.

Henderson Island (Elizabeth Island), 1921, Quayle, no. 394, type.

A fairly distinct variety intermediate between *D. punctata* and *D. marquisensis*. Area of distribution includes Henderson Island and Mangareva.

4. *Dianella intermedia* Endlicher var. *nukuhivensis*, new variety (fig. 17, d).

Leaves 30-100 cm. in length, $9-25 \pm$ mm. in width, obscurely spinulose-serrate or nearly smooth; tepals 5-6 mm. long the outer series of medium width, 5-veined, not distinctly punctate, greenish-white or lilac; inner series decidedly wider, 3-veined, not distinctly punctate, with a hyaline border as wide as or wider than the central veined portion; filaments shorter than the anthers, as a rule; seeds $4 \pm$ mm. in length, $2.3 \pm$ mm. in width.

Marquesas, Nukuhiva, Tovii, altitude 900 meters, July 15, 1921, F. Brown, no. 514, type. Marquesas, Nukuhiva, altitude 300 meters (?), 1922, Quayle, no. 1271 (dwarf; leaves $30 \pm$ cm. in height, $9 \pm$ mm. in width, spinulose-serrate along the margin and keel; tepals 5 mm. in length, the outer series 5-veined, faintly punctate, lilac in color; inner tepals 3-veined, distinctly wider, with a broad hyaline, nearly white border, very faintly punctate), reference type. Frequent at moderate to high elevations in Nukuhiva, Marquesas; also occurs in Tahiti and Raiatea, Society Islands.

2. *Dianella odorata* Blume.

Leaves 50-100 cm. in length, $10-25 +$ mm. in width, smooth along the margin and keel; panicle as long as the leaves or longer; tepals 5-7 mm. in length, the outer ones lilac in color, 5-7 veined, not distinctly punctate; inner tepals commonly 5-veined, with a broad, white hyaline border.

Marquesas, Fatuhiva, Omoa-Ouia Trail, altitude 700 meters, January 20, 1921, F. Brown, no. 899 (leaves $35 \pm$ cm. in length, $11 \pm$ mm. in width, smooth along the margin and keel; panicle as long as the leaves; tepals 6 mm.

in length, not punctate, the outer series lilac in color, 5-6-veined, the inner series commonly 5-veined, with a broad white, hyaline border), reference type.

Rare in the Marquesas; collected only on Fatuhiva, where it is known as *mouupa*, the Tahitian native name for *D. intermedia* Endlicher. Of frequent occurrence in Hawaii, where it is known as *uki*.

3. ***Dianella sandwichensis*** Hooker and Arnott.

Leaves as in *D. odorata*; flowers small; tepals 5-6 mm. in length, not distinctly punctate; outer tepals lilac in color, 5-veined; inner tepals 3-veined, nearly white (Skottsberg, 42, p. 216); seed $4 \pm$ mm. in length.

Marquesas, Nukuhiva, Tovii, altitude 900 meters, December 20, 1921, F. Brown, no. 871 (leaves $80 \pm$ cm. in length, 24 mm. in width, smooth along the margin and keel; tepals 5 mm. in length, not distinctly punctate; outer tepals 5-veined, lilac in color; inner tepals commonly 3-veined, nearly white; plant is remarkably similar to Forbes no. 2055, Waimea Valley, Oahu, and Rock, no. X, Waikane, Oahu, reference type.

The native name *kie kie maha* in the Marquesas. The native name in Hawaii is *uki*.

The area of distribution includes the Marquesas and Hawaii.

FAMILY 9. AMARYLLIDACEAE

Similar to Liliaceae, but the ovary inferior; fruit septicidal; seeds small, numerous. No indigenous species in the Marquesas.

KEY

- 1. Flowers one or few at end of a scape.....1. ***Zephyranthes***
- 2. Flowers forming an umbel at the end of a scape.....2. ***Hymenocallis***

I. ZEPHYRANTHES Herbert

1. ***Zephyranthes rosea*** Lindley.

Perennial; leaves linear, 20-30 cm. long, 5 \pm mm. wide, from an underground bulb; flowers rose-colored, 2.5 \pm cm. in length, 3 \pm cm. broad.

Mangareva, May, 1, 1922, E. H. Quayle, no. 449; Marquesas, Hivaoa, December, 1921, F. Brown, no. 948; reference types.

Native of Cuba; of recent introduction in the Marquesas, Tuamotus, Society Islands, Hawaii, and Samoa, where it flowers with little cultivation.

2. **HYMENOCALLIS** Salisbury

Perennial from a subterranean bulb; leaves linear to narrowly lanceolate; flowers bisporangiate; perianth tubular, with 6 elongated segments; 6 stamens;

filaments united at the base; anthers elongated, versatile; ovulary trilocular, with 2 ovules in each locule; style simple.

About 30 species, natives of tropical America; one species from Africa.

1. *Hymenocallis littoralis* Salisbury.

Leaves broadly linear 1 ± meters in length; bulb 6-10 + cm. in diameter; scape 60 ± cm. in length, bearing 6-8 + subsessile flowers at the summit; bracts 5 ± cm. in length, 2 ± cm. in width, acute; flowers white, very fragrant; tube of perianth 18 ± cm. in length, with 6 narrowly linear segments 10 ± cm. in length; stamens and style subequal to the perianth segments in length, the versatile anthers 1.5 ± mm. in length (dry specimen).

Marquesas, Nukuhiva, Taipi Vai, August 19, 1921, F. Brown, no. 686, reference type.

The native name is *riri* in the Marquesas. The flowers are made into leis or worn over the ears.

A native of tropical America, it is probably of late introduction in the Marquesas, where it occurs frequently in inhabited valleys throughout the archipelago, growing in alluvial soil. One of the largest areas is in Omoa, Fatuhiva, where several acres are covered. Flowers during August.

FAMILY 10. TACCACEAE

Perennials with starchy tubers; leaves large, entire or divided; flowers bisporangiate; ovulary inferior, unilocular, with 3 parietal placentas; fruit a capsule or berry.

A small tropical family with no indigenous representatives in the Marquesas.

I. TACCA Forster

About 17 species in Asia, Africa, America and Pacific islands.

1. *Tacca pinnatifida* Forster (Pl. XXXII).

Leaves net-veined; petioles 1 ± meters in length; blade 50-100 ± cm. in diameter, without a distinct intramarginal vein, divided into 3 irregularly cut divisions; inflorescence umbellate, the flowers numerous on filiform pedicels 2-3 + cm. long; involucre bracts numerous, the outer ones 6 ± in number, lanceolate or ovate, 3-5 + cm. in length, acute or obtuse, the inner ones numerous, filiform, 10-20 + cm. long; perianth campanulate, 15 + mm. in length, greenish, with 6 acute lobes 10 mm. long; stamens 6, inserted at the base of the perianth lobes, the filaments short, arched, concave in the upper portion, enclosing the anthers; style short; stigma divided into 3 spreading, obcordate lamellae; fruit a berry.

Marquesas, Nukuhiva, Taiohae, May 27, 1921, F. Brown, no. 1112; Nukuhiva, Hakau, July 20, 1921, F. Brown, no. 506; reference types.

The leaves resemble those of the *teve* (*Amorphophallus campanulatus*)

but are readily distinguished by the longitudinally furrowed petiole and the absence of a well defined intramarginal vein.

The native name is *pia* in the Marquesas, Society Islands, Samoa, and Hawaii; also called *pia taki oho au* in Hakau, Nukuhiva. In the Marquesas the tubers are frequently prepared for food, especially on festive occasions; the petioles are cut into short sections and made into leis. The Marquesans, unlike the Tahitians, seldom use the fiber of the flower stalk in weaving.

Native of tropical Asia; probably of aboriginal introduction in the Marquesas and other parts of Polynesia.

FAMILY 11. DIOSCOREACEAE

Stems slender, climbing or procumbent, herbaceous, rarely somewhat woody, the subterranean portion commonly tuberous; leaves alternate or opposite entire, palmately lobed or divided; flowers small, commonly in axillary racemes, monosporangiate, monoecious or dioecious, the perianth 6-parted; 6 stamens or staminodia; ovulary superior, trilocular; 3 stigmas; fruit a capsule or berry.

About 500 species widely scattered in the tropics; 2 or 3 Asiatic species widely distributed in Polynesia are probably of aboriginal introduction.

I. DIOSCOREA Linnaeus

Herbaceous or somewhat woody climbers; smooth or prickly; leaves alternate or opposite; flowers monosporangiate, dioecious, as a rule; 6 stamens or 3 stamens and 3 staminodia, or all rudimentary; fruit a capsule.

Approximately 450 species widely distributed in the Tropics; the 2 or 3 species which are widely distributed in Polynesia are probably of aboriginal introduction.

KEY

- 1. Leaves alternate (2)
- 1. Leaves opposite.....2. **Dioscorea alata**
- 2. Stem smooth (3)
- 2. Stem prickly at base.....4. **Dioscorea cayensis**
- 3. Leaves entire.....1. **Dioscorea bulbifera**
- 3. Leaves palmate.....3. **Dioscorea pentaphylla**

1. **Dioscorea bulbifera** Linnaeus (Pl. XXIX, A).

Herbaceous vine climbing to a height of 2-15 + meters; stem slender, glabrous, twining, cylindrical or obtusely quadrangular, nonalate, green or reddish; leaves alternate, glabrous, the blades cordate, broadly oval to suborbicular, 10-25 + cm. long and nearly as broad or slightly narrower, abruptly contracted to an acuminate apex, the primary veins prominent, 7-13 + in number; petioles as long as or somewhat shorter than the blades, spirally coiled or twisted at the thickened base; staminate flowers 2 ± mm. in length, with 2 unequal bractlets at the base, arranged in slender racemose spikes 5-10 +

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cm. in length which are either arranged in axillary fascicles of 2-5 + each, or the fascicles disposed in axillary or terminal racemes 10-40 + cm. in length, the perianth segments $2 \pm$ mm. in length, the 6 stamens shorter than the perianth, inserted at the base of the cup; carpellate flowers disposed in slender axillary racemes or spikes 20-40 + cm. in length, which are clustered in fascicles of 2-5 + each, the perianth segments $2 \pm$ mm. in length, or nearly one-half the length of the adnate ovulary, the 6 stamens reduced to staminodia, the style short, bearing 3 obcordate stigmatic lobes; axillary tubers present or absent, or present only on one or more branches, subspherical, 1-10 + cm. in diameter, deep-greenish, reddish, or grayish-brown, marked by prominent spirally arranged scars, the interior tissues white, stored with triangular starch granules 20-40 μ in diameter.

Marquesas, Fatuhiva, Hanavave, January, 1922, F. Brown, nos. 900 and 900A (carpellate); Nukuhiva, Taipi Vai, August 19, 1921, F. Brown, no. 583 (staminate); Nukuhiva, Hakau, June 16, 1921, F. Brown, no. 453 (a plant with reddish-green stems); reference types.

The above description is based on Marquesan material. Observations made on living plants from Marquesas and Society Islands and upon dry material from other parts of Polynesia indicate considerable variation in the size, shape, and venation of the leaves, and in the presence or absence and size of aerial tubers, even in different parts of the same plant. The large aerial tubers of some of the Polynesian forms are doubtless the result of native cultivation.

Dioscorea sativa Linnaeus (28, p. 1033) instead of *D. bulbifera* Linnaeus (28, p. 459, Pl. XXVIII) has been the common and generally accepted name for the bitter yam which is widely distributed in Polynesia. Under the name *D. sativa* it appears in the following citations from the botany of the Pacific islands; Bentham (3, p. 368, and 4, p. 461); Drake (14, p. 226); Hillebrand (22, p. 483); Hooker (23, p. 295); Nadeaud (32, no. 256); Rechinger (34, p. 71); Seemann (39, p. 308). However, some specimens of the Polynesian bitter yam bear tubers over 10 cm. in diameter, while the specimen represented by Linnaeus, serving as the type for *D. sativa*, does not bear aerial tubers. Furthermore, careful analytical study of the drawing gives reason for believing that it is a composite drawing from material representing more than one species. (See Kunth, 26, note p. 91.) Therefore, in the present treatment Kunth has been followed, and *D. sativa* has been rejected in favor of *D. bulbifera* Linnaeus (28, p. 1033), which is described as having aerial bulbs.

The native names are *hoi* in the Marquesas, Society Islands, Hawaii, and Fiji; *soi* in Samoa; *oi* in Rarotonga. The form in the Marquesas is known as *hoi kua* (red yam). The common English name is bitter yam.

Although the aerial tubers and the subterranean ones, which grow to large size, are said to be edible after long baking or boiling, they are used for food only in times of famine. According to the Marquesans the tubers from the staminate plant are inferior in quality to those from the carpellate plants. It is of no economical importance.

A native of tropical Asia, it is probably of ancient aboriginal introduction in the Marquesas, where it occurs frequently in all inhabited valleys.

2. *Dioscorea alata* Linnaeus (fig. 15, b).

Perennial herbaceous vine climbing to a height of 4-10 + meters; stems sharply quadrangular, the angles winged; leaves opposite, the blades broadly ovate-cordate, acuminate, 10-20 + cm. in length, glabrous, $9 \pm$ veined; petiole somewhat shorter than the blade; aerial tubers turbinate, $5 \pm$ cm. long, the interior tissues stored with coarse starch grains, elliptical in outline, up to 63μ in length and 29μ in width; subterranean tubers large, up to 50 + cm. in length and 15 cm. in diameter.

Marquesas, Fatuhiva, Hanavave Valley, F. Brown, no. 891; Hivaoa, Atuona, December 8, 1921, F. Brown, no. 830; Nukuhiva, Tapi Vai, August, 1921, F. Brown, no. 587; reference types.

The native names are *puahi* in the Marquesas; *ui-parai* in Rarotonga; *uhi* in Tahiti; *ufi* in Samoa; and *uhi* in Hawaii. In Hawaii *uhi* is also applied to *Smilax sandwicensis* Kunth, the rhizome of which is edible. The common English name is yam. The aerial and subterranean tubers, although edible when cooked, are not preferred to taro or breadfruit by the Marquesans. The plant is now cultivated to some extent for its edible tubers.

Native of tropical Asia, of aboriginal introduction in the Marquesas, where it is of frequent occurrence in all inhabited valleys.

3. *Dioscorea pentaphylla* Linnaeus.

Herbaceous vine climbing to a height of $10 \pm$ meters, the stem somewhat angular, prickly, pubescent; leaves alternate, palmately 3-5-foliolate, the leaflets lanceolate, acute-acuminate, 7-15 cm. in length, marked with translucent bars, contracted at the base into a short petiolule, the common petiole nearly as long as the leaflets; axillary tubers small, absent in some specimens; subterranean tubers large.

Marquesas, Fatuhiva, Hanavave, January, 1922, F. Brown, no. 1083, reference type.

The native names are *utau* in the Marquesas; *pirita* in Rarotonga; *piia* in Hawaii, according to Hillebrand. The common English name is yam. The subterranean tubers were used as food by the early Marquesans. The plant is now cultivated to a limited extent for its edible tubers.

Native of India; of probable ancient aboriginal introduction in the Marquesas, where it is common in all inhabited valleys.

4. *Dioscorea* sp. (fig. 15, c).

Vine, climbing to a height of $10 \pm$ meters, the stem woody, spine bearing, $2 \pm$ cm. in diameter, with slender, smooth, herbaceous branches; leaves alternate, hastate, up to 10 cm. in length, acute, the basal lobes obtuse, 7-9-veined, glabrous, irregularly marked with short, translucent bars; petiole nearly as long as the blade, twisted at the base. Tubers $8 \pm$ cm. in diameter,

the outer covering deep-brown with a thin reddish inner layer, the interior creamy-white, composed of cells stored with coarse, broadly ellipsoidal starch grains 58μ in length.

Marquesas, Fatuhiva, Omoa Valley, altitude 800 meters, January, 1922, F. Brown, no. 990, reference type.

The material is not sufficient for accurate determination, but it appears to be near to, if not identical with, *D. cayenensis* Lamarck, a native of Africa, widely cultivated at an early date in tropical America.

The native name is *puahi peahi* in Fatuhiva; the common English name, yam. The subterranean tubers are highly esteemed by the natives for food. They are not cooked but crushed and coconut cream added. They may also be boiled in water or baked in the native oven. Their taste is very similar to the Irish potato.

Very rare in the Marquesas. Only a single specimen was found in Fatuhiva, the southernmost island of the archipelago. Doubtless of early aboriginal introduction, and, if *D. cayenensis*, which it closely resembles, it would further indicate contact with America.

FAMILY 12. MUSACEAE

Herbaceous perennials; leaves alternate, spirally arranged or 2-ranked; inflorescence terminal, spicate or paniculate; flowers zygomorphic, mono-sporangiate, monoecious or dioecious; 5-6 stamens; ovulary inferior, trilobular; fruit a capsule or berry.

About 70 species in the tropics; no indigenous species in the Marquesas.

I. MUSA Linnaeus

Tall, commonly treelike herbs with a perennial rhizome; leaves large, pinnately veined, petiolate, sheathing; inflorescence terminal, racemose, the basal flowers carpellate, the apical flowers staminate, as a rule; perianth parted on the dorsal side; 5 stamens, with a sterile, rarely fertile, sixth; ovulary trilobular; fruit a berry, seedless in cultivated varieties; seeds subglobose, a hard outer covering.

About 41 exclusively Old World species.

KEY

- | | | |
|---|----|-------------------------|
| 1. Fruit cluster erect..... | 2. | Musa fehi |
| 1. Fruit cluster pendent (2) | | |
| 2. Plant dwarf, 2-3 meters in height..... | 3. | Musa cavendishii |
| 2. Plant tall, 6 ± meters in height..... | 1. | Musa paradisiaca |

1. *Musa paradisiaca* Linnaeus (Pl. XXIX, C).

Plant 3-8 + meters in height; stem enclosed in concentric leaf-sheaths, forming a small cylindrical trunk-like support $15 \pm$ cm. in diameter; rhizome thick, stoloniferous; leaves large, elliptical, $2.5 \pm$ meters in length, $60 \pm$ cm. in width; inflorescence and fruit cluster pendent.

Marquesas, Uapou, altitude 650 meters, September 13, 1922, Quayle, no. 1170, reference type.

The native names are *meika* (northern dialect) and *mei'a*, rarely *meika* (southern dialect), in the Marquesas; *mei'a* in Tahiti; *maia* in Hawaii. Not less than 75 varieties seem to have been cultivated by the ancient Marquesans. Of those, all but 8 in the following list were collected on the southern islands.

Meika ake.—Northern dialect.

Mei'a oomanu.—Fatuhiva.

Mei'a avea.—Fatuhiva; one of the best native varieties.

Mei'a ehuo.—Fatuhiva.

Mei'a hakamau.—Hivaoa.

Mei'a kapaahi.—Fatuhiva; medium size, seedless.

Meika keopiha.—Hatiehu, Nukuhiva; fruits of large size.

Mei'a kina.—Fatuhiva; a variety with long fruits.

Mei'a koka.—Hivaoa.

Mei'a koo.—Fatuhiva.

Meika kooteu.—Hatiehu, Nukuhiva.

Meika kopehu.—Northern dialect; said to be the same as *mei'a opeu*, southern dialect.

Mei'a ma'oi.—Hivaoa, Fatuhiva; (*meika ma'oi*, northern dialect). The most ancient variety, claimed to be the one from which all other Marquesan varieties were derived, through cultivation and selection.

Mei'a meu.—Fatuhiva.

Mei'a napea.—Fatuhiva; seeds present.

Mei'a natau.—Fatuhiva.

Meia nonokia or nonoia.—Fruits small, in long bunches.

Mei'a oha.—Fatuhiva.

Meia olea.—Fatuhiva; the letter *l* of rare occurrence in Marquesan plant names; fruits small.

Mei'a olua.—Fatuhiva; name of interest because of *l*.

Mei'a opehe.—Fatuhiva.

Mei'a opeu.—Southern dialect; said to be the same as *meika kopehu*, northern dialect.

Meika peehatu.—Hatiehu, Nukuhiva.

Mei'a petanui.

Meika (mei'a) petavii.—The most celebrated of all ancient Marquesan varieties, and, according to all information, now extinct. A few old native Marquesans remember it growing luxuriantly in Tovii, Nukuhiva, at an altitude of $900 \pm$ meters, but in 1921-22 not a plant could be found in that region or elsewhere in the Marquesas. This is doubtless due to the presence of semiwild cattle and pigs. Marquesans who have seen this variety describe the plant as growing to a large size and readily distinguished from other varieties by the spiral arrangement of the fruits on the long drooping cluster. The skin of the fruit as well as the flesh is said to have been yellow.

Meika pivai.—Fruits in large clusters.

Mei'a poupou.—Hivaoa and Fatuhiva; fruits broadly ellipsoidal, large.

Mei'a puapua.—Fatuhiva; medicinal.

Mei'a puhautea.—Hivaoa.

Meika pukokiva.—Nukuhiva.

Mei'a puou.—Hivaoa.

Meika puroiva.—Fruit large, long, yellow; commonly prepared for food by baking in the native oven; said to have originated on Uapou, from which island it was brought to Taipi Vai, Nukuhiva.

Mei'a taa-i-vaio.—Fatuhiva; medicinal.

Mei'a takuua.—Fatuhiva.

Meika tapuahi.—Northern dialect.

Mei'a tapu-vae-kua.—Fatuhiva; fruits elongated, large; see *mei'a uapu-vae-kua*.

Mei'a tuhua.—Fatuhiva.

- Mei'a opuauiva.—Fatuhiwa.
 Meika orea or oreha.—Hatihu, Nuku-
 hiva; *mei'a orua*, Hivaoa; name of in-
 terest from occurrence or *r*.
 Mei'a oveo.—Fatuhiwa.
 Mei'a paa fatu.—Southern dialect; said to
 be same as *meika paa hutu*, northern
 dialect; medicinal.
 Meika paa hutu.—See *mei'a paa fatu*.
 Mei'a pako.—Hivaoa.
 Mei'a pao.—Fatuhiwa; fruits small.
- Mei'a tupau.—Fatuhiwa.
 Mei'a uahaa.—Fatuhiwa.
 Mei'a uaoa.—Fatuhiwa.
 Mei'a uapaahi.—Hivaoa.
 Mei'a uapu-vae-kua.—Hivaoa; said to be
 same as *mei'a tapu-vae-kua* of Fatu-
 hiva.
 Mei'a uekiteki.—Hivaoa.
 Mei'a uhiau.—Fatuhiwa and Hivaoa.
 Mei'a vaa-i-vao.—Hivaoa.

The following additional varietal names of native banana appear in Dordillon's dictionary (13): *faafaa*, *faeta*, *fanaua*, *haa-moe-pua*, *haetu*, *ihupi*, *kamanu*, *kaupe*, *koonui*, *mahoki*, *mooi*, *onua*, *orua*, *pu*, *tekiteki*, *tikikaha* or *tiikaha*, *timaei*. None of the natives questioned remember any of the varieties included in this list, and no specimens were found during the survey.

Common European names are banana and *banane*. The banana (*Musa paradisiaca*) seems to have been one of the first plants introduced by the Marquesans and a leading food plant in the beginning period of Marquesan agriculture. This is indicated by their thorough understanding of the cultural requirements of the plant, the development of numerous cultural varieties and the knowledge of all its useful properties in connection with ancient native practice. However, at the time of European discovery, the banana had become very subordinate to the breadfruit as a food plant.

Practically all parts of the plant were used. Ripe raw fruits served as *inani* with *popoi* or as dessert. In times of great shortage, the fresh fruit was used in the place of breadfruit or taro in the making of *popoi*. However, this kind of *popoi* was made only in an emergency, as it fermented quickly and was slightly sweet in taste. Also, the fruits were baked in the native oven or substituted for breadfruit, in combination with coconut cream, to form some of the old native delicacies. The fruits of certain varieties were selected for sacrificial offerings in ancient times.

A strong alcoholic drink is made from the fermented fruit.

The outer tissues of the trunk (leaf sheaths) stripped into narrow ribbons, were used as cordage. The green leaves served as the external or outer lining of *ma* pits for storing the fermented breadfruit. Passing them quickly over an open fire caused them to wilt and become tough and pliable. In this state they were used for wrapping food to be baked in the native oven. Especially were they preferred for the wrapping of foods containing coconut milk, while the leaves of *ti* (*Cordyline*) were preferred for fish and foods of which the *ma* was a constituent. (See p. 144.)

The juice and green tissues of several varieties of bananas were used in native medicinal practices. Small green trunks, preferably of the variety *ma'oi*, which had been pounded until flattened and nearly all the juice ex-

tracted, were laid over the hot stones in the native oven to prevent the burning of the food and to keep it moist. This precaution was always taken if food containing coconut was being baked.

At the present time, native bananas are less valued for raw food than those of modern introduction. Doubtless this is because the native varieties are better adapted for cooking. Of the introduced varieties, the *pime* banana ranks first. While growing to a greater height and bearing prolifically, its vigorous root system seems to anchor the plant firmly to the ground, making it more wind-resistant than the native varieties. *Corne d'boeuf* is preferred for cooking; so named from the slight resemblance of the curved fruit, which grows to a length of 20 to 30 cm., to a beef's horn. All varieties yield abundantly with little cultivation in all the large river valleys of the Marquesas. Varieties of native cultivation occur in all inhabited valleys of the Marquesas, particularly in Hivaoa and Fatuhiva.

2. *Musa fehi* Bertero.

Herb, 6 ± meters in height, with reddish trunk and leaf veins; inflorescence and fruit clusters erect; fruit angular, ellipsoidal, red or yellowish-red to greenish, the interior flesh deep-yellow when baked; seeds absent in most varieties, rarely present.

Three varieties were cultivated by the Marquesans on the island of Fatuhiva: *huetu atiu*, bearing red fruits of medium size; *huetu nafa*, forming mature seeds in some fruits; and *huetu popo*, bearing red fruits of large size. The native names are *huetu* in the Marquesas, *fei* in Tahiti. The common English name is *fei*. The fruit was used as food, when baked in the native oven or boiled in water. Also it served for medicinal purposes. The raw fruit was cut in half and a portion from the tip end applied externally as a poultice for inflammation; especially used in cases of elephantiasis. The juice from the outer tissues of the trunk was also used for the same purpose.

Native of New Caledonia; probably of ancient aboriginal introduction in Tahiti, whence it was brought, according to native tradition, to the Marquesas.

3. *Musa cavendishii* Lambert.

A small plant about 2 meters in height, with small fruits. Considered inferior to the *pime* as raw food.

Of recent introduction in the Marquesas, where it is cultivated to a small extent in all large valleys. The common name is "Chinese banana."

FAMILY 13. ZINGIBERACEAE

Perennial herbs with a tuberous rhizome; starch grains large, elliptical to subcircular, marked with eccentric lines; leaves ligulate, with linear, lanceolate, or oblong, asymmetrical blades and long sheaths, sessile or petiolate; inflorescence spicate, racemose or paniculate; flowers zygomorphic, commonly

bisporangiate, rarely monosporangiate-dioecious; calyx and corolla tubular, each 3-lobed; a single fertile stamen, the filament commonly wrapped around the filiform style; ovulary inferior, 1-3-locular, containing many ovules; fruit a capsule or berry; seeds with aril.

About 800 species widely scattered in the tropics; no indigenous species in the Marquesas.

KEY

1. Shoots of two kinds, (a) floriferous and (b) foliaceous (4)
1. Shoots foliaceous, bearing a terminal inflorescence (2)
2. Rhizome with deep-yellow interior.....1. **Curcuma**
2. Rhizome with white or light-yellow interior (3)
3. Tube of corolla long and slender.....2. **Hedychium**
3. Tube of corolla with short tube.....3. **Alpinia**
4. Inflorescence ellipsoidal; connective narrow, elongated.....4. **Zingiber**
4. Inflorescence commonly subglobose; connective dilated.....5. **Amomum**

I. CURCUMA Linnaeus

Rhizome thick, perennial, tuberous; stems erect, with sublanceolate, commonly petiolate leaves, bearing a terminal spicate inflorescence, the flowers each subtended by a spathe-like bract; calyx tubular, 2-3-dentate; corolla tubular, the lobes short and subequal; a single bilocular anther with a petaloid filament; ovulary inferior, trilocular.

About 39 species, natives of the Old World.

1. **Curcuma longa** Linnaeus (Pl. XXVIII, A; fig. 15, a).

Aerial shoots herbaceous, unbranched, $70 \pm$ cm. in height, with a short stem bearing a terminal spike of flowers, the entire aerial shoot withering to the ground after flowering; rhizome perennial, deep-yellow, aromatic, forming elongated tubers $15 \pm$ cm. in length and $2 \pm$ cm. in diameter, the interior tissues filled with (1) coarse, elongated, eccentrically striated starch granules $58 \pm \mu$ long, $28 \pm \mu$ wide; (2) large amber-colored globules of pigment (curcumin) $97 \pm \mu$ in diameter; and (3) small, colorless globules of fragrant ethereal oil; leaf blades thin, glabrous on both surfaces, lanceolate or oblanceolate, acuminate, 20-60 cm. in length and 4-14 cm. in width, narrowed gradually into a slender petiole commonly nearly as long as the blade; bracts of inflorescence broadly lanceolate, acute, 3-7 cm. in length, 1-2 cm. in width, pale-green; calyx 1 cm. in length; corolla tubular, 3 cm. in length, white or yellowish, the lobes $1 \pm$ cm. in length; anthers cordate at the base, $1 \pm$ mm. in length. (This description is based on the Marquesan reference types listed below.)

Society Islands, Tahiti, Papeete, February 28, 1921, F. Brown, no. 198. Marquesas, Hivaoa, Atuona, Feani (Keiani) Valley, December 8, 1921, F. Brown, no. 835; Fatuhiva, Omoa Valley, January 20, 1922, F. Brown, no. 918; Nukuhiva, Taiohae, June 6, 1922, F. Brown, no. 115. Samoa, February 28, 1921, A. J. Eames, no. 107. Austral Islands, Rurutu, Tuamoa, February 20, 1921, Stokes, no. 133; Raivavae, Rairua, March 23, 1922, Stokes, no. 41; Tubuai, April, 1922, Aitken, no. 904. Rapa, December 26, 1921,

Stokes, no. 438. Samoa, June and July, 1920, W. A. Setchell, no. 299. Reference types.

The native names are *ago*, *ano*, and *vailema* in Samoa; *cago* in Fiji; *eka* (northern dialect) and *ena* (southern dialect) in the Marquesas; *lea* in Rapa; *olena* in Hawaii; *rea* in Tahiti and Tubuai; *tegea* in Raivavae; *terea* in Tuamano, Rurutu; *talea* in the Tuamotu Islands. The common English name is turmeric; incorrectly called "saffron."

The Marquesans distinguished the following varieties:

Ena avaava.—Fatuhiva; tubers yellow (Brown no. 918).

Ena fiti.—Hivaoa and Fatuhiva; tubers deep-orange (Brown no. 835).

Eka hei.—Nukuhiva; tubers large light-yellow, said to have been obtained from Tahiti (Brown no. 115).

Eka hitipue.—Hatiehu, Nukuhiva.

Ena kakao.—Fatuhiva.

Eka ma'oi.—Tuber rather small, orange. This is said to be the oldest variety and is doubtless the one from which all other Marquesan varieties were derived by native methods of cultivation. It is the one selected for ceremonial uses.

Eka moa.—Hatiehu, Nukuhiva.

The *eka* (or *ena*) was used as dye, medicine, flavoring for food, perfume, and ceremonial purposes. However, the Marquesans cultivated it chiefly for the bright-yellow dye contained in the tuber. Tapa was dyed chrome-yellow by means of this dye. The crushed tissues added to coconut oil imparted a fragrant odor to the oil. The tubers were employed in cooking in a manner similar to curry powder in modern cooking.

For ceremonial purposes the tuber of *eka ma'oi*, after the skin had been removed by scraping, was wrapped in leaves and baked in the native oven until soft. Then it was placed in a piece of native cloth (tapa) and the juice squeezed out. This juice was used as an ointment for young girls and boys who were tapu for the dances at feasts; never for old people. Two anointings were used to give the desired color to the skin.

A valuable dye and condiment is yielded by the rhizome. One of the most important uses of the dye is the manufacture of turmeric paper, employed in chemistry as a delicate test for alkali. It is made by treating a specially prepared absorbent paper with an alcoholic solution of curcumin. Also the condiment forms one of the ingredients of curry powder.

A native of India, there, as in islands of the Indian Ocean, it has been cultivated since prehistoric time for dye and condiment. Of aboriginal introduction in the Marquesas, it is found growing luxuriantly with little cultivation in all inhabited valleys.

2. HEDYCHIUM Koenig

Perennials from a tuberous rhizome; leaves 2-ranked, sheathing, ligulate; inflorescence spicate or subpaniculate; flowers solitary or few from a common

bract; calyx tubular, divided on one side; tube of corolla slender, longer than the calyx; lobes of corolla linear, reflexed; lateral staminodia petal-like; labellum prominent, commonly 2-lobed, stamen longer or shorter than the labellum; fruit a trilocular capsule.

About 30 species, natives chiefly of southern Asia and the Malay archipelago.

KEY

1. Flowers white; calyx glabrous.....1. **Hedychium coronarium**
 1. Flowers yellow; calyx pubescent.....2. **Hedychium flavum**

1. **Hedychium coronarium** Koenig.

Herb 1-2 meters in height, from perennial tuberous rhizome; leaves sessile, lanceolate, acuminate, acute at the base, glabrous on the upper surface, pubescent on the upper surface, pubescent or subglabrous below, 8-60 + cm. in length, 3-11 cm. in width; ligule membranous, 2-3 cm. long; inflorescence terminal, spicate, ellipsoidal, 5-12 cm. in length (not including the flowers); bracts 4-5.5 cm. in length, closely imbricate, 2-3-flowered; calyx 4 ± cm. in length, glabrous; corolla white, very fragrant, the tube slender, 8 cm. in length, the 3 lobes 3-3.5 cm. in length, lanceolate, spreading; 2 lateral staminodia petal-like, white, lanceolate, obtuse; labellum somewhat shorter, broadly obcordate, white with yellow center; stamens subequal to the labellum, white; anther 12 ± mm. in length.

Marquesas, Nukuhiva, Taiohae, March 13, 1922, F. Brown, no. 998, reference type.

Native of India, Himalaya region; of recent introduction in the Marquesas.

2. **Hedychium flavum** Roxburgh (Pl. XXVIII, B).

Hedychium coronarium Koenig var. *flavescens* Carey.

Plant 1.6 ± meters in height, from a perennial rhizome; leaves apetiolate, lanceolate, 20-40 + cm. long, 5-8 + cm. wide, acuminate, acute at the base, the upper surface glabrous, the under surface covered with weblike hairs, especially along the midvein; ligule membranous, 4 ± cm. long; inflorescence terminating tall leafy shoots, spicate, 15 ± cm. long, exclusive of the flowers; bracts loosely overlapping, broadly ovate or ellipsoidal, 5-6 cm. long, acute or obtuse, pubescent or subglabrous, coriaceous, each with 4 ± flowers in the axil; calyx 4-5 cm. long, membranous, the outer surface pubescent, especially at the apex and base; corolla cream-yellow, very fragrant, the tube 8-9 cm. long, twice the length of the calyx, the 3 lobes linear or linear-lanceolate, 4-4.5 cm. long, reflexed at the time of flowering; 2 lateral staminodia petal-like, yellow, lanceolate, or subspatulate, obtuse, 4-4.5 cm. in length; labellum very broadly obovate, 3-4 cm. in width, emarginate or 2-lobed, abruptly contracted into a claw, yellow, deepening in shade toward the center and base; stamen subequal to the labellum in length, yellow, the anther 10-12 mm. long. (This description, based on the Marquesan reference types, agrees in detail with that of Schumann (38, p. 45), based on material from India).

Marquesas, Fatuhiva, Omoa, January 20, 1922, F. Brown, no. 938; Nukuhiva, Taiohae, November 1, 1921, F. Brown, no. 800. Austral Islands, Rurutu, March 15, 1921, Stokes, no. 207. Rapa, December 26, 1921, Stokes, no. 437. Samoa, Upolu, February 15, 1921, Eames, no. 11. Reference types.

The species is closely allied to *H. coronarium* Koenig, from which how-

ever, it is readily distinguished by its yellow flowers, yellow stamen, the linear, reflexed corolla lobes, pubescent calyx, longer spikes with loosely overlapping bracts, longer ligule, and more pubescent undersurface of the leaves.

The native names are *eka puhi* in Nukuhiva and *opuhi* and *kokopuhi* in the southern dialect of the Marquesas (the same names are applied to *Zingiber zerumbet*, leaves of which somewhat resemble those of *H. coronarium* in shape and size); *opui* in Rurutu; *kapi* in Rapa; *makiliki* in Samoa. The common English name is yellow ginger. The flowers are used for leis.

Native of India; of early introduction in the Marquesas, where it is occasionally found in nearly every inhabited valley from sea level to an altitude of 600 + meters; also introduced in most high islands of Polynesia.

3. ALPINIA Linnaeus

Shoots herbaceous from a perennial rhizome or tuber, bearing leaves and finally flowers; leaves ligulate, petiolate or sessile, with long sheaths. Inflorescence terminal, racemose to subpaniculate; calyx with 3 teeth or lobes; corolla tube commonly as long as the calyx or longer; labellum commonly longer than the corolla tube, 2-3-lobed; a single fertile stamen with parallel anther locules; ovulary 1-3-locular; ovules numerous; fruit a capsule with few to many seeds in each locule.

About 150 species, natives chiefly of the tropical western Pacific islands.

1. *Alpinia purpurata* (Vieillard) K. Schumann (Pl. XVI, A).

Description amended by F. Brown to include forms under cultivation in southeastern Polynesia:

Shoots 1-5 meters in height; leaves shortly petiolate or without distinct petiole, lanceolate to oblong-lanceolate, acute or acuminate, cuneate at the base, 20-80 + cm. in length, 8-14 + cm. in width, glabrous; ligule 5-10 + mm. in length, obtuse, glabrous or pubescent; racemes 10-90 cm. in length, bright purplish-red, with little odor; rachis puberulous, glabrate or glabrous; bracts broadly lanceolate, 3-6 cm. long, obtuse to subacute, puberulous to glabrous near the base, ciliate or glabrous on the margin, bright purplish-red; short, simple, and erect, or long, pendent, and, in some specimens, branched at the base; flowers 1-2 in number from the axil of each bract, rarely maturing in several cultivated forms; pedicel 1-2 mm. in length; ovulary glabrous, commonly unilocular in the upper portion; calyx 2-3 cm. long, acutely bidentate, split on one side; corolla nearly white, the tube slender, 27 ± mm. in length, curved, the lobes lanceolate-obtuse, 9-12 + mm. long; labellum shorter than the lobes, distinctly or indistinctly 2-4-lobed, crisp; filament short; anther 3 + mm. in length, the filament projecting beyond the anther in the form of a 3-lobed hood 2 ± mm. long over the stigma, which is bell-shaped, 1 ± mm. broad, ciliate,

Unless grown under favorable conditions, the cultivated forms in the Marquesas and other parts of tropical Polynesia are small, 2 ± meters in height; ligule longer than typical, 5-10 + mm. in length, commonly puberulous; leaf blades commonly 30 ± cm. in length, rarely 80 cm. in length; spikes commonly 20 ± cm. in length, erect, unbranched; rarely 90 cm. in length, pendent, branched at the base; rachis commonly glabrous to glabrate; bracts commonly sterile, rarely with a developed flower, ciliate to glabrous on the margin.

Cultivated to a very limited extent by the Marquesans on account of its showy red inflorescence; apparently not associated with their ancient material culture. This is one of the most desirable plants for landscape gardening in the high islands of Polynesia.

Native of tropical western Pacific islands; the cultivated forms are probably of comparatively late introduction in the Marquesas and other high islands throughout tropical Polynesia. However, it is not unlikely that the Polynesians may have cultivated this plant to some extent, transplanting it from one island to another (Schumann, 38, note, p. 234) although the absence of a Marquesan native name makes it seem unlikely. In Hawaii the native name is *awa puhi ula*. The common English name is red ginger.

2. *Alpinia speciosa* (Wendland) Schumann.

Alpinia nutans Roscoe.

Shoots 2-3 + meters in height; leafblades lanceolate, acuminate, up to 70 cm. in length and 10 cm. in width, puberulous along the margin; ligule 1 cm. long, obtuse, pubescent; petiole short; inflorescence spicate paniculate, nodding, 30 ± cm. in length, white, red, and yellow; rachis puberulent; bracts 2-3-flowered, up to 3 cm. long, broadly elliptical, white with red at the apex and base; flowers shortly pedicellate; ovulary tomentose; calyx up to 1.8 cm. long, campanulate, white, 2-lobed, coriaceous; corolla white, the tube 10 ± mm. long with lobes 3 cm. long, red at the apex; labellum 4 cm. long, indistinctly 3-lobed, spotted and striped with red; stamen nearly one-half the length of the labellum; staminodia subulate, 2 ± mm. long.

Austral Islands, Raivavae, April 18, 1922, Stokes, no. 61. Society Islands, Tahiti, June and July, 1922, Setchell, no. 261. Reference types.

Native of southeastern Asia; of recent introduction in the Marquesas and other high islands of tropical Polynesia, where it is a desirable plant for landscape gardening. The native name is *opuhitoa* in Raivavae.

4. ZINGIBER Linnaeus

Herbs with perennial rhizomes; shoots commonly of two kinds, leaf-bearing and flower-bearing; inflorescence spicate, terminating a scapelike, leafless shoot; calyx tubular, commonly split on one side; corolla tubular, 3-lobed; 2 lateral staminodes adnate with and forming the apparently lateral lobes of the labellum; filaments of the single fertile stamen prolonged beyond the anther; ovulary trilocular, many-ovulate; fruit a capsule.

About 35 species. Native of India, Malaysia, and neighboring islands; no indigenous species in the Marquesas.

KEY

- | | |
|-----------------------------|-------------------------------|
| 1. Leaves 3-6 cm. wide..... | 1. <i>Zingiber zerumbet</i> |
| 1. Leaves 1-3 cm. wide..... | 2. <i>Zingiber officinale</i> |

1. *Zingiber zerumbet* (Linnaeus) Smith.

Shoots erect from the rhizome, of two kinds: (1) sterile, leaf-bearing, 30-80 + cm. in height, the leaves 2-ranked, lanceolate, acute, 10-25 + cm. in length, 3-6 cm. in width, hairy on the under surface, glabrous above, tapering gradually into a short petiole 5 ± mm. in length, the ligule membranous, 1-2 cm. in length, the sheaths overlapping, enclosing the stem, and more or less pubescent; (2) floriferous shoots 15-30 cm. in length, leafless, scapelike, with remote sheathing scales 4 cm. in length, bearing at the summit an ellipsoidal conelike spike 8 ± cm. in length, 4 ± cm. in diameter, with closely overlapping, spirally arranged bracts; flowers pale-yellow, the tubular portion covered by the subtending bract; labellum suborbicular, 1.8 + cm. in diameter, the middle lobe notched at the apex.

Marquesas, Hivaoa, Paumau, April 22, 1921, F. Brown, no. 345; Nukuhiva, Hakau, July 6, 1921, F. Brown, no. 677; Hivaoa, Atuona, December 8, 1921, F. Brown, 836; Cook Islands, Rarotonga, January 26, 1921, F. Brown, no. 176. Rapa, 1921, Quayle, no. 370. Rapa, October 31, 1921, Stokes, no. 380. Austral Islands, Rurutu, February 17, 1921, Stokes, no. 74; Rurutu, February 17, 1921, Stokes, no. 129; Raivavae, Rairua, March 23, 1922, Stokes, no. 57. Reference types.

According to Schumann (38, p. 172), the leaves may be glabrous on both surfaces. But the under surface of the leaves is hairy, never glabrous, in all specimens examined by the author from the Marquesas, Society Islands, Cook Islands, and Austral Islands.

Like other Polynesians the Marquesans have more than one name for this plant: *kokopuhi* and *kokopu* in Fatuhiva, Uapou, and in Taiohae, Nukuhiva; *eka pui* in Hakau, Nukuhiva; *awa pui* in Hawaii; *rea moru* in Tahiti; *kapi* in Rapa; *tata* in Rurutu and *opuhi* in Raivavae, Austral Islands; *ava pui* in Samoa. Common English name in Hawaii is wild ginger.

The clear watery juice which can be squeezed from the inflorescence was sprinkled upon the hair, both to cleanse it and to cause it to lie smoothly. This seems to have been a common custom, not only in the Marquesas, but in Hawaii and Rarotonga and elsewhere in Polynesia. In emergencies, when water, coconuts, or pineapples were not available, the juice was squeezed into the mouth to quench thirst. The foliage is spicy in fragrance and was used by the Marquesans to scent tapa. The Hawaiians used the plant for the same purposes as the Marquesans. The statement made by Hillebrand (22, p. 434): "The natives made no use of it" is erroneous. It forms a ground cover in the mesophytic forest.

The area of distribution of the species includes India and Malaysia; doubtless of early aboriginal introduction in all high islands of tropical Polynesia, where it has become naturalized; common at an altitude of 500 ± meters in the Marquesas.

2. *Zingiber officinale* Roscoe. (See Schumann 38, p. 171, fig. 23.)

Shoots of two kinds, leaf-bearing and flower-bearing, each from a perennial tuberous, creeping rhizome. (1) Leaf-bearing shoots $1 \pm$ meters in height; leaves apetiolate or nearly so, lanceolate to linear-lanceolate, acute, 15-30 + cm. in length, 1-3 + cm. in width; ligule $5 \pm$ mm. in length, glabrous. (2) Flower-bearing shoot scapelike, $25 \pm$ cm. in length, with leaves reduced to sheathing scales, terminating in a short, few-flowered spike $5 \pm$ cm. in length, 2-3 cm. in diameter; bracts ovate, cuspidate, $25 \pm$ mm. in length, greenish-yellow; calyx $1 \pm$ cm. in length, corolla greenish-yellow, with a tube $2 \pm$ cm. in length; lobes of corolla as long as the tube, lanceolate, acute; labellum oblong-obovate, somewhat shorter than the corolla lobes, 3-lobed; stamen as long as the labellum.

Marquesas, Nukuhiva, Taipi Vai, August 15, 1921, F. Brown, no. 577. Society Islands, Tahiti, Papeete, March 13, 1921, F. Brown, no. 211; reference types.

The native name is *eka kiva* (Chinese *eka*) in Nukuhiva; the English trade name, commercial ginger. Although the ginger of commerce grows fairly well in the Marquesas it is not cultivated on a commercial scale. The natives make little use of it.

A native of the Molucca Islands?; of recent introduction in the Marquesas.

5. *AMOMUM* Linnaeus

Shoots commonly of two kinds from a perennial rhizome, (1) sterile, leaf-bearing, and (2) floriferous; inflorescence cone-shaped, terminating a leafless scape; calyx tubular, tridentate; corolla with 3 subequal or somewhat unequal lobes; staminodia reduced to toothlike vestiges; labellum broad, subentire, or 2-lobed; filament short; locules of anther parallel or divergent, the connective, as a rule, produced beyond the locules into a short, dilated apex; ovulary commonly trilocular.

About 80 species, natives of the tropical parts of the Old World; no indigenous species in the Marquesas.

1. *Amomum cevuga* Seemann (Seemann 39, p. 291, Pl. L89).

Description amplified by F. Brown.

Herb 2-4 meters in height, from a perennial rhizome; tissues of the plant spicy, aromatic; shoots (1) foliaceous and (2) floriferous; leaf blades oblong-lanceolate, caudate-acuminate, $35 \pm$ cm. in length, $6 \pm$ cm. in width, glabrous, or pubescent along the margin; petiole $1 \pm$ cm. in length; ligule 4-8 mm. in length, glabrous or ciliate along the margin; inflorescence subglobose, from a conical red-bracteate base, $6 \pm$ cm. in diameter, tapering to a red-bracteate peduncle $8 \pm$ cm. in length; outer bracts numerous, imbricate, red, the upper ones $4 \pm$ cm. in length, subacute, the lower ones shorter, entire or emarginate; floriferous bracts tubular, calyx-like, 2-lobed, pilose on the outer surface, 2 cm. in length; flowers shortly pedicellate; calyx tubular, 2 cm. in length, with 3 triangular acute teeth; corolla white to light-pink, the tube as long as the calyx, the lobes $1 \pm$ cm. in length; labellum obovate, emarginate, $1.5 \pm$ cm. in length, light-pink; ovulary and stigma villose; filament very short; anther 5-7 mm. in length, villose, the thecae divergent at the apex, with the dilated end of the connective in the sinus.

Society Islands, Tahiti, October 14, 1921, Quayle, no. 124; Tahiti, June 22, 1922, Setchell, no. 420; Tahiti, altitude 50 ± meters, May 7, 1927, MacDaniels, no. 1297; reference types.

The native names are *opuhi* in the southern Marquesas and Society Islands, *eka pua vao* in the northern Marquesas, *cevuga* in Fiji, *awapuhi* in Tahiti. The foliage is used for thatch or native beds in Tahiti, and the flowers for wreaths and scenting coconut oil in Fiji. Doubtless of relatively late introduction in the Marquesas from Tahiti. It occurs rarely and is not familiar to the native Marquesans.

FAMILY 14. CANNACEAE

Perennials, with pinnately veined leaves and showy flowers; 3 free sepals, 3 petals; staminodia petal-like; a single fertile unilocular anther with a petaloid filament; ovulary inferior, trilocular; style compressed; stigma terminal.

About 30 species all native of warm climates of America; 1 species pantropic.

I. CANNA Linnaeus

Herbs with perennial rhizome; inflorescence terminal, racemose; bracts and sepals small; corolla lobes subequal; capsule globose, echinate-tuberculate, indehiscent; seeds globose, with a hard outer covering.

1. *Canna indica* Linnaeus.

About 1.5 meters in height; leaf blades 50 ± cm. in length, 20-25 cm. in width, acute, petiolate or apetiolate; raceme simple, with short branches and long sheathing bracts; sepals 1 + cm. in length; petals lanceolate, 3-4 cm. in length, red, petaloid; androecium segments 3-5 cm. in length, bright-red; labellum red-spotted.

Marquesas, Nukuhiva, Taiohae, September 1, 1923, F. Brown, no. 636; Nukuhiva, Hakau, June 9, 1921, F. Brown, no. 415. Mangareva, 1921, Quayle, no. X. Society Islands. Tahiti, September 14, 1921, Quayle, no. 16. Rapa, Quayle, no. 325. Samoa, Tutuila, June and July, 1920, W. A. Setchell, no. 535. Rapa, June 6, 1921, Stokes, no. 16. Fiji, Mothe, August 14, 1924, Bryan, no. 476. Reference types.

The following native names, which vary greatly in different parts of Polynesia, signify very little in the way of classification: *eka pua-vao*, northern dialect, Marquesas, where the canna is classed with *Curcuma* (*eka*), which, in fact, it resembles more closely than any other plant of early introduction; *aliipoe* in Hawaii; *fauamanu* in Samoa; *linga* in Rapa. The common English name is canna. The canna is cultivated to a limited extent for its showy flowers and is one of the best flowering perennials for landscape planting in Polynesia.

Native of tropical America; pantropic; of rather late introduction in the Marquesas, where it occurs both naturalized and cultivated in nearly every inhabited valley.

FAMILY 15. ORCHIDACEAE

Herbs; inflorescence racemose; flowers commonly bisporangiate, zygomorphic; perianth superior, composed of 2 trimerous cycles, corolla-like, the 2 lateral divisions (petals) of the inner cycle similar, the third forming a variously shaped labellum; stamens 2-cyclic, incompletely developed; floral axis prolonged around and over the ovary, forming a column to which the one or more fertile anthers and the stigma are attached; pollen united into 2-8 pollinia, of which half are contained in each locule of the anther; pollinia with or without a stalk or caudicle, at the end of which a glutinous fluid is secreted; ovary inferior, tricarpellate, unilocular or trilocular; gynoeceum with or without a beaklike rostellum, the middle lobe of which projects beneath and between the free ends of the hornlike anther thecae, the 2 lateral lobes of the rostellum being rolled partly around the acute end of the anther theca directly above, where a beadlike globule of glutinous liquid is secreted at the end of the caudicle; stigma close to and below the rostellum, sub-circular, concave, convex, or elongated and 2-lobed or 2-parted; fruit a capsule with 3-6 longitudinally dehiscent divisions, rarely a berry; seeds minute, numerous, without endosperm.

A family of about 15,000 species best represented in the mountainous regions of the Tropics; 3 genera in the Marquesas, all representatives of which have close relatives in the Society Islands.

KEY

- | | |
|---|------------------------------|
| 1. Scandent..... | 5. Vanilla |
| 1. Erect or pendent (2) | |
| 2. Leaves large, 50 ± cm. in length, dark-green (3) | |
| 2. Leaves small, under 50 cm. in length (4) | |
| 3. Column short, adnate with the labellum..... | 4. Calanthe |
| 3. Column elongated, free from the labellum except at the base..... | Phajus (Brown, 7) |
| 4. Leaf-bearing stem tall, 15 + cm. in length; pollinia stalked..... | 6. Habenaria |
| 4. Leaf-bearing stem short, pollinia not stalked (5) | |
| 5. Inflorescence terminal (6) | |
| 5. Inflorescence lateral (8) | |
| 6. One leaf, rarely two leaves | 3. Liparis (Brown, 7) |
| 6. Several leaves (7) | |
| 7. Leaves equitant..... | 2. Oberonia |
| 7. Leaves not distinctly equitant..... | 1. Microstylis |
| 8. Leaves numerous, not crowded at regular intervals along slender, erect or pendent stems..... | Dendrobium (Brown, 7) |
| 8. Leaves few (9) | |
| 9. Stem very short..... | Phreatia (Brown, 7) |
| 9. Stem slightly elongated..... | Eria (Brown, 7) |

I. MICROSTYLIS Nuttall

Terrestrial herbs with leaf-bearing stems; pseudobulbs present or absent; leaves few, thin, sheathing at the base; inflorescence terminal, racemose; flowers small; petals narrower than the sepals as a rule; labellum sessile at the base of the column, with 2 auricles at the base directed upward around it; column very short, with 2 projecting edges; anther erect; 4 pollina; capsule ovoid.

This genus, for which 250 species are reported, is best represented in America, Malaysia, and New Guinea; few species in Africa and Madagascar; 2 species in Fiji; 1 each in Samoa, Rarotonga, Rurutu, and the Society Islands; absent from Australia, New Zealand, Hawaii, and the Marquesas.

KEY

1. Flowers minute, about 2 mm. in diameter.....1. *Microstylis margaretae*
 1. Flowers over 4 mm. in diameter.....*Microstylis resupinata* (Brown, 7)
 1. *Microstylis margaretae*, new species, (fig. 18, b).

Terrestrial herb 15 ± cm. in height; rhizome short, creeping; leaf-bearing stem short, suberect, 3 ± cm. in length, somewhat thickened, forming an ill-defined pseudobulb at the junction with the rhizome; leaves 4 ± in number, the blades lanceolate-acuminate, subacutely contracted at the base, glabrous, 3-5 veined, 6-15 cm. in length, 3-5 + cm. wide, narrowed at the base, forming a petiole 3-7 + cm. in length, sheathing at the base; scape 10 ± cm. in length, bearing in the lower portion 10 ± linear-lanceolate bracts 5-10 mm. in length, the upper floriferous bracts slightly shorter; pedicel and ovulary 1 ± mm. in length before the opening of the flower; flowers very small, numerous, light-yellow (?), racemose, crowded near the end of the scape; lateral sepals very broad, 1-veined, punctate, 1.5 ± mm. in length and nearly as broad at the time when the flower begins to open; posterior sepal of nearly the same length, punctate, 1-veined, relatively narrow, 0.5 ± mm. in width; labellum broadly cordate, with a shallow sinus, 1.5 ± mm. in length before expanding, nearly as broad as long, the anterior margin coarsely dentate, the laciniae 6-8 ± in number. (The description of the flower is based on young not fully opened specimens.)

Austral Islands, Rurutu, Uropepe, altitude 200 ± meters, February 17, 1921, Stokes, no. 105, type.

The species is evidently closely related to *M. reineckiana* Kränzlin of Samoa, which was described by Reinecke (35, p. 600) and illustrated by Rechinger (34, Pl. 1). *M. reineckiana* is considered a near relative of *M. bancanae* of Banca Island near Sumatra, and it is somewhat less closely allied to the Indo-Malayan *M. rheedii*. *M. margaretae* differs from *M. reineckiana* in the following characters: (1) the short, suberect stem; (2) somewhat larger 3-5-veined leaves, and in comparison with the illustration for *M. reineckiana*; (3) in the more numerous laciniae of the labellum. *M. margaretae* is much less primitive than *M. resupinata* (Forster) Drake of the Society Islands and slightly more primitive than *M. reineckiana*.

Endemic in Rurutu.

2. OBERONIA Lindley

Epiphytes; pseudobulbs absent; leaves equitant with compressed sheaths; stems short; inflorescence terminal, racemose; flowers small; sepals free, subequal; petals relatively narrow; labellum sessile, 2-3-lobed; column short; anther terminal; 4 pollinia; capsule small, subglobose.

About 200 species centering in New Guinea ($70 \pm$); fairly represented in India, Java, Sumatra, Philippines, and Celebes; few in Australia and Polynesia; absent from New Zealand and America, 1 species in the Society Islands; not collected in the Marquesas.

1. *Oberonia glandulosa* Lindley.

Epiphytic herb, $10 \pm$ cm. in height; leaves 5-10 in number, triangular-lanceolate, the apex acute (not lobed), $1.7 +$ cm. in length, $1 \pm$ cm. wide at the base, equitant, glabrous, pale-green; inflorescence racemo-spicate, terminal, $10 \pm$ cm. in length, the rachis, pedicels, bracts, and ovaries glandular-pubescent throughout, floriferous to within a short distance of the base; bracts narrowly lanceolate, $2 \pm$ mm. in length, shorter than the flower; flowers minute, somewhat crowded, light-yellow to nearly white, one from the axil of each bract; pedicel $1 \pm$ mm. in length; ovary 2 mm. in length, $1 \pm$ mm. in diameter; perianth glabrous on the inner surface; sepals pubescent outside, broadly ovate-acute, $1 \pm$ mm. in length, $0.7 \pm$ mm. in width; petals relatively narrow, one-half the width of the sepals and slightly shorter, subacute; labellum broadly obovate, cuneate, emarginate at the apex, $1 \pm$ mm. long and nearly as broad; capsule subglobose, $1.8 \pm$ mm. long, glandular-pubescent, with 6 subulate angles.

Tuamotu Islands, Makatea, altitude 100 meters, August 18, 1922, Jones, no. 861. Samoa, Tutuila, June and July, 1920, W. A. Setchell, no. X. Austral Islands, Rurutu, Upopepe, altitude $400 \pm$ meters, February 17, 1921, Stokes, no. 82. Society Islands, Tahiti, Papenoo Valley, altitude 200 meters, May 19, 1927, MacDaniels, no. 1516, Tahiti, Maire Valley, altitude 100 meters, June 7, 1927, MacDaniels, no. 1643; Tahiti, Varao, altitude 400 meters, June 15, 1927, MacDaniels, no. 1681. Reference types.

The inflorescence of specimens from Rurutu and Makatea are not as pubescent as those from the Society Islands, and the rachis is somewhat thicker in some specimens.

The native names are *hoe* in Rurutu; *auta* and *vao sosolo i le ma'a* in Samoa. The area of distribution includes Tahiti, Raiatea, Borabora, Society Islands; Rurutu, Austral Islands; Makatea, Tuamotus; Rarotonga, according to Cheeseman (11, p. 207); Tutuila, Samoa; Fiji. Absent from the Marquesas.

3. LIPARIS Richard

Perennial herbs, epiphytic or terrestrial, the stem thickened at the base, as a rule, forming a pseudobulb; leaves 1-6 in number; inflorescence terminal, racemose; flower small, greenish-yellow; petals and sepals linear to lanceolate, alike in shape, or the petals relatively narrow; labellum broad,

entire or emarginate; column incurved, commonly with 2 short triangular wings near the end; anther bilocular, operculate, attached at the end of the column; pollinia waxlike, 4 in number, united at the apex into twin pairs, one pair in each locule of the anther.

About 300 species in the genus, which ranks second only to *Habenaria* as the most widely distributed genus of the Orchidaceae. It is best represented in New Guinea (about 70 species) and Indo-Malaya (about 60 species). About 50 species occur in Africa and near islands; about 25 species in America and the West Indies; 1 or more species in Borneo, the Philippines, New Caledonia, Celebes, Society Islands, Cook Islands, Samoa, Marquesas, Rapa, Hawaii, and Fiji; only 4 species in Australia; none in New Zealand. One species, *Liparis loeselii*, common to Europe and America, is of interest on account of its affinity with species occurring in Hawaii and the Marquesas.

KEY

- | | |
|--|------------------------------------|
| 1. Leaves elliptical..... | <i>Liparis revoluta</i> (Brown, 7) |
| 1. Leaves cordate (2)..... | 1. <i>Liparis clypeolum</i> |
| 2. Fruiting pedicel 15 ± mm. in length..... | 1a. var. <i>marquisensis</i> |
| 2. Fruiting pedicel 10-11 mm. in length..... | 1b. var. <i>rapensis</i> |
| 2. Fruiting pedicel 7 ± mm. in length..... | <i>tahitensis</i> (Brown, 7) |

1. *Liparis clypeolum* Lindley.

Original description amplified by F. Brown.

Epiphytic or growing on moist soil or rocks; roots clothed with felted hairs; stem 15-30 + cm. in height, obscurely to sharply triangular, thickened at the base, forming a pseudobulb ovoid in shape, 3 ± cm. in height and 2.5 ± cm. in diameter, bearing a single basal leaf, which loosely sheathes the basal third portion of the stem; 2 or 3 other leaves reduced to basal sheaths, the first of which is nearly as long as the inner blade-bearing sheath, the second half as long, the third small or absent; blade of leaf thick and succulent when green, thin when dry, broadly cordate, 7-16 + cm. in length, 5-12 + cm. in width, triangular-acuminate at the apex, the basal lobes clasping the stem and overlapping, the lower portion of the leaf contracted, forming an open sheath 5-10 + cm. in length, which loosely clasps the pseudobulb and the lower third of the stem; surface glabrous; veins numerous, numbering 20-60 +; inflorescence racemose, the flowers occupying the upper third of the stem, 20-35 +, yellow to greenish, supported on twisted, filiform pedicels 9-17 + mm. in length, including the slender ovulary; bracts small, triangular, lanceolate, acute, the floriferous ones 1-2 + mm. long, the sterile ones rarely as long as 5 mm.; sepals lanceolate, 1-3 veined at the base, 1-veined in the upper portion, 7-8 mm. long, 2-2.2 mm. wide; petals narrow, linear, 7-8 mm. in length, 0.4-0.5 mm. in width, 1-veined; labellum broadly obcordate, commonly cuspidate in the center, 7-8 + mm. in length, 7-9 mm. in width; cusp up to 1 + mm. in length; column 3 mm. in length, curved, 2-ate near the end; anther lidlike cordate-orbicular in outline, bilocular, 1.3 ± mm. in length, with 2 pollinia in each locule; capsule obovoid, 10-12 mm. in length, 4-5 mm. in width, prominently tricostate; fruiting pedicel 7-15 mm. in length.

Occurs at high altitudes on trees or moist soil in the Marquesas; Rapa; in Tahiti at an altitude 2,500 ft. (Setchell, 41); in Rarotonga (Cheeseman, 11).

1a. *Liparis clypeolum* Lindley var. *marquisensis*, new variety (Pl. XXXII).

Pedicels and ovulary 12-17 + mm. in length; bracts $2 \pm$ in length; sepals $8 \pm$ mm. in length, $2.2 \pm$ mm. in width; petals $8 \pm$ mm. in length, $0.5 \pm$ mm. in width; labellum 7-8 mm. in length, 8-9 mm. in width, yellow, with prominent brownish or purplish veins; cusp $1 \pm$ mm. in length; capsule 10-12 mm. in length, $4 \pm$ mm. in width; fruiting pedicels $15 \pm$ mm. in length.

Marquesas, Nukuhiva, Tovii, July 20, 1921, F. Brown, no. 509, type. Marquesas, Nukuhiva, Tovii, September ?, 1922, no. 1232, Uapou, September 9, 1922, Quayle, no. 1150; Marquesas, Fatuhiva, Omoa, January 11, 1921, F. Brown, no. 881. Reference types.

A watery extract obtained from the crushed tissues of the plant was applied externally for burns or inflammation; the colorless sap squeezed from the flowers and stem, diluted with water, was a remedy for indigestion. The native name is *autahi* (single leaf) in the Marquesas.

This relatively primitive variety is of frequent occurrence at high altitudes of $1,000 \pm$ meters, in the cloud zone of Nukuhiva, Uapou, and Fatuhiva, Marquesas. All specimens collected were growing as epiphytes on the branches and inclined trunks of *Hibiscus tiliaceus* and other trees; endemic in the Marquesas.

1b. *Liparis clypeolum* Lindley var. *rapensis*, new variety.

Capsule $10 \pm$ mm. in length, $4 \pm$ mm. in diameter; fruiting pedicel 10-11 mm. in length; flowers unknown.

Rapa, Maitua, altitude 190 meters, on talus, October 10, 1921, Stokes, no. 327, type. Rapa, Maitua, in coffee plantation, altitude 166 meters, August 15, 1921, Stokes, no. 131, reference type.

According to Mann (29, p. 207), *L. hawaiiensis* is intermediate between *L. loeselii*, a bog plant common to Europe and North America, and *L. liliifolia* of the Mississippi Valley. *L. cardiophylla* Ames, from high altitudes (2000 meters) in Jamaica, and *L. neuroglossa*, *L. elegantula*, *L. ramosa*, occurring at high altitudes in the Andes, appear to be other near relatives of *L. hawaiiensis* and suggest an American origin for it.

The relatively greater age and primitiveness in *L. hawaiiensis* in comparison with *L. clypeolum* is indicated in the following distinguishing characters of *L. hawaiiensis*: (1) the presence of a second leaf blade; (2) in the large labellum 10 mm. in length, $7 \pm$ mm. in width; (3) the large, distinctly 3-veined sepals, 10 mm. long, 2.5 mm. wide; (4) the long petals 10-13 + mm. in length, $1 \pm$ mm. in width; (5) the long pedicel and ovulary, $16 \pm$ mm. in length; (6) the long bracts 2-6 mm. in length; (7) the large capsule 10-14 mm. in length and 4-5 mm. in width; (8) the long column 3.5 mm. in length; (9) the long fruiting pedicel of 10-15 mm. in length. It is obvious that *L. clypeolum* may have been derived from an antecedent very

similar to *L. hawaiiensis*, by the complete reduction of one leaf-blade, leaving only the sheath in *L. clypeolum*, which never bears even so much as a rudimentary blade. A slight reduction has occurred in the size of the fruiting capsule and pedicel and in all parts of the flower. The completely 3-veined sepal in *L. hawaiiensis* is reduced to a smaller partly 3-veined sepal in the relatively young *L. clypeolum*, and there has been an increase in the size of the pseudobulb. A parallel process of reduction has occurred in the evolution of *L. revoluta* of the Society Islands from an antecedent similar to the Indo-Malayan *L. longipes*.

As *L. hawaiiensis* is evidently much older than any variety of the closely allied *L. clypeolum*, the distribution and relative age of these high-mountain species and varieties indicates a remote, possibly early Tertiary, migration of an antecedent similar to *L. hawaiiensis* from the region of Hawaii, south and eastward, probably along the ridge upon which Palmyra, Fanning, and numerous other low islands are situated, to the region of the Tuamotus. At a considerably later period, the varieties of *L. clypeolum* were evolved and dispersed from a hypothetical pre-Tuamotuan center to the Marquesas, Rapa, Tahiti, and the Cook Islands. Inasmuch as these plants occur exclusively at high altitudes, this assumption implies that the Line Island chain and the Tuamotus were mountainous at the time of migration, supporting mountain floras sufficiently near to permit interisland dispersal by birds. This conclusion is sustained by numerous other genera present in the Marquesan flora.

The juice squeezed from the crushed tissues of the plant, diluted with water, was taken internally as a remedy for sore throat.

Endemic in Rapa, where the native name is *opialapoa*.

4. CALANTHE R. Brown

Terrestrial herbs with or without pseudobulbs; few leaves, basal or cauline, coarsely veined, plicate; inflorescence racemose, terminating a tall, lateral, axillary, or, apparently, terminal scape; flowers bisporangiate; sepals subequal; petals similar to the sepals or relatively narrow; labellum adnate to the column, spreading, 3-4-lobed, the base terminating in a tubular spur; column short, erect, united at the sides with the labellum; anther operculate, attached at the end of the column; pollinia 8, elongated, tapering to a common junction, 4 in each locule of the anther.

About 200 species centering in Indo-Malaya; few in Africa, Madagascar, or America; 1 white-flowered species, *C. veratrifolia*, distributed in numerous forms from Asia through Malaysia to Australia, eastward to Samoa; 30 ± species widely scattered in the Pacific islands; absent from Europe and New Zealand.

Calanthe gracillima and *C. tahitensis* evidently represent two independent eastward migrations from the region of Samoa to the region of the Society Islands and the Marquesas, the antecedent of *C. gracillima* arriving later than that of *C. tahitensis*. The relative antiquity of *C. tahitensis* is indicated partly in its differentiation into well defined varieties, partly by the relatively wide distribution of the varieties, and partly by the fact that the 2 species do not form a closely connected genetic series. The extreme eastward migration to the region of the Marquesas may have occurred during a (Tertiary ?) period of high emergence of the Tuamotus.

KEY

1. Spur decidedly longer than the sepals; flowers white; labellum glabrous, longer than broad.....*Calanthe gracillima* (Brown, 7)
 1. Spur shorter than or subequal to the sepals in length; flowers yellow, labellum pubescent, shorter than broad.....*Calanthe tahitensis* (2)
 2. Veins of labellum prominent (3)
 2. Veins of labellum obscure.....10. var. *marquisensis*
 3. Anterior portion of labellum subligulate in shape, emarginate at the apex, the lateral sinuses wide open.....var. *typica* (Brown, 7)
 3. Anterior portion of the labellum deltoid in shape, the lateral sinuses very narrow.....var. *deltoides* (Brown, 7)
1. ***Calanthe tahitensis* Nadeaud.**

Original description amplified by F. Brown from reference types cited below :

Perennial, terrestrial herb $1 \pm$ meters in height; rhizome short; leaf-bearing stem 5-50 cm. in length; leaves 3-5 + in number; the blades 10-60 + cm. long, 3-12 + cm. in width, acuminate, glabrous, permanently dark-green, subplicate, with $7 \pm$ prominent longitudinal veins and numerous smaller ones, tapering gradually to a concave petiole 10-30 + cm. in length, $1.5 \pm$ cm. in width near the blade, widening somewhat and sheathing at the base; scape axillary, in some plants terminal ?, 50-140 + cm. in height, terminating in a raceme of yellow flowers, puberulent throughout the flower-bearing portion, finally subglabrous below, with $6 \pm$ remote sterile bracts 2-6 cm. long; raceme many-flowered, with 1 or 2 flowers from the axil of each bract; pedicel and ovary 1-2 + cm. in length, subtended by a narrowly lanceolate, acute, puberulent bract somewhat shorter than the pedicel and ovary; sepals broadly lanceolate, acute or subacute, thick and rather firm in texture, puberulent on the outer surface, 3-veined \pm , 8-9 + mm. in length, 3-5 + mm. in width, yellow or greenish-yellow, with a dark exterior; petals nearly equal to the sepals in length but much narrower, obovate-spatulate, 5-8 + mm. long, 2.5-3 + mm. wide, obtuse or acute, 1-veined on the average, bright-yellow; labellum (cream color?), broader than long, pubescent or puberulent, 7-9 mm. long 8-12 + mm. wide, typically 3-lobed, with a long, emarginate, terminal lobe, also 4-lobed, the 2 lateral lobes relatively large, typically auriculate but varying to subtruncate at the base, 4-6 mm. long and $4 \pm$ mm. broad; lateral sinuses 2-3 mm. deep, typically very wide at the opening but varying to narrow; anterior portion elongated and emarginate at the apex or inversely triangular and 2-lobed, 2.5-5 mm. long, 4-6 + mm. broad at the apex, $3 \pm$ mm. broad and $3 \pm$ veined in the neck, with an apical sinus or notch of $1 \pm$ mm. in depth; spur short, 3-8 mm. in length, thick, 1.5-2 + mm. in diameter, shorter than or subequal to the sepals, pubescent; pollinia narrowly obovoid,

8 in number, $1.8 \pm$ mm. long; capsule ellipsoidal, $2 \pm$ cm. in length, $9 \pm$ mm. in width; fruiting pedicel 5 mm. long.

Evidently more closely allied to the Samoan *C. lutescens* than to the Tahitian *C. gracillima*, from which it differs greatly in the color of the flowers, and in the shape, surface, and venation of the labellum.

1a. *Calanthe tahitensis* Nadeaud var. *marquisensis*, new variety, (fig. 18, a).

Inflorescence puberulous; pedicel and ovulary $1 \pm$ cm. in length; sepals 8 mm. in length; 3-4 mm. in width, subcoriaceous, 3-veined, greenish-yellow, with a dark exterior; petals bright-yellow, narrowly obovate, $7 \pm$ mm. in length, 2.5-3 mm. in width, 1-3-veined; labellum $8 \pm$ mm. long, $10 \pm$ mm. wide, light-yellow?, obscurely veined, cuneately rounded at the base, the 2 anterior lobes $5 \pm$ mm. broad, $2.5 \pm$ mm. long, diverging at an angle of less than 90 degrees, forming an apical sinus $1.5 \pm$ mm. long; lateral sinuses very narrow, with the lobes overlapping; spur $8 \pm$ mm. in length, subcoriaceous in texture, broad, $1.5 \pm$ mm. in diameter, pubescent.

Marquesas, Fatuhiva, Omoa Valley, along the Omoa-Ouia trail, altitude $750 \pm$ meters, January, 1922, F. Brown, no. 1005, type.

The native name is *vahane vao* in the Marquesas. Collected only on Fatuhiva, Marquesas, where it is of occasional occurrence in moist valleys.

5. VANILLA Swartz

Tall, scandent herbs; flowers moderately large; sepals and petals subequal; labellum adnate with the column, concave, clasping the column at the base; capsule commonly long, fleshy, nondehiscent.

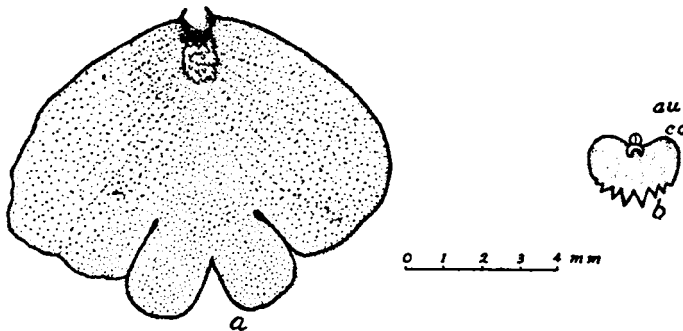


FIGURE 18.—Labella of Orchidaceae: a, *Calanthe tahitensis* var. *marquisensis*; b, *Microstylis margaretae*.

The vanilla is of recent introduction in the Marquesas, where it is cultivated to a limited extent in Nukuhiva, Fatuhiva, Uapou, and Hivaoa. The young kapok (*Ceiba pentandra*), is the most common support upon which the vanilla vine is trained, trees 7-12 cm. in diameter being grown or planted for this purpose. Productive plantations are to be found at an altitude of

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500 to 600 meters, where the plant yields well with little cultivation. The flowers are pollinated by hand, native labor being used; later the fleshy capsules are harvested and dried for export. *V. aromatica* Swartz and *V. planifolia* Andrade, or hybrids of these species, are the ones most commonly grown; also cultivated on a commercial scale in the Society Islands.

Marquesas, Hivaoa, Atuona, December 18, 1921, F. Brown, no. 875, reference type.

6. HABENARIA Willdenow

Terrestrial herbs; pseudobulbs commonly present; inflorescence terminal, racemose; sepals subequal; petals subequal to the sepals or relatively narrow, entire or lobed or parted; labellum commonly 3-5-lobed or parted, spurred at the base; column short; anther 2-locular, subterminal, commonly more or less adnate to the surface of the column; pollinia stalked, 2 in each locule of the anther, the stalk terminating in a sticky globule.

One of the most widely distributed genera of the Orchidaceae, comprising $800 \pm$ species, with a primary concentration ($300 \pm$ species) in North and South America, and a secondary center ($250 \pm$ species) in Africa; relatively few species occur in Asia ($85 \pm$ species) or the East Indies ($60 \pm$ species). A few species are widely scattered in the Pacific islands.

KEY

1. Leaves crowded at the base of the flower-bearing scape...1. **Habenaria tahitensis**
2. Leaves at regular intervals.....2. **Habenaria marquisensis**

1. **Habenaria tahitensis** Nadeaud (Pl. XVII, C).

Herb, $80 \pm$ cm. in height; leaves $8 \pm$ in number from the central portion of the stem, lanceolate, $25 \pm$ cm. long, $5 \pm$ cm. wide, glabrous, dark-brown when dry, contracted at the base, forming a closed sheath $4 \pm$ cm. in length, the lower leaves reduced to sheaths; scape terminal, bearing flowers in the upper third and sheathing or clasping acute bracts 1-5 cm. long in the lower portion, glabrous throughout; inflorescence racemose, subspicate, many-flowered, $20 \pm$ cm. in length, $4 \pm$ cm. in diameter; inflorescence bracts acute; pedicel and ovary $15 \pm$ mm. long, subtended by a lanceolate, acuminate bract of nearly the same length; flowers greenish, odorless; sepals broadly ovate, acute, mucronate, 3-veined, $12 \pm$ mm. in length, the lateral ones spreading, the third concave; petals spreading, each divided into 2 divergent 1-veined segments, of which the upper one is lanceolate and somewhat shorter than the sepals, the lower one linear, falcate and commonly narrower than the upper one; labellum divided into 3 rather thick linear divisions, the middle division longer than the lateral ones and subequal to the sepals; spur slender, $1 \pm$ mm. in diameter, nearly three times the length of the sepals; stigmatic processes 2, 1 on each side of the mouth of the spur, ligulate, $2 \pm$ mm. long, obtuse, divergently curved at the apex; column very short; 2-auriculate, rugose-punctate staminodia, one attached to each lateral face of the column; middle lobe of rostellum broadly triangular, $2 \pm$ mm. in height, the apex projecting between the free acute ends of the anther thecae; lateral lobes $2 \pm$ mm. in height, each one rolled partly around the acute end of the anther theca directly above it; pollinia 2, ellipsoidal, 2 mm. long, composed of 2 plano convex coarsely granular pollen masses attached to a filiform caudicle of nearly the same length.

Marquesas, Uapou, altitude 400 to 700 meters, September 11, 1922, Jones, no. 1168, type of description. Marquesas, Nukuhiva, Taipi Vai, altitude 500 meters, July, 1922, Charles Henry, no. 563, reference type.

The Marquesan specimen appears to differ slightly from the description of *H. tahitensis* from Tahiti, and in all probability may prove to be a distinct variety. Material available from Tahiti, however, is not sufficient for accurate comparison.

Area of distribution includes the Society Islands and the Marquesas.

2. *Habenaria marquesensis*, new species (Pl. XVII, D).

Herb $50 \pm$ cm. in height, the stem leaf-bearing throughout; leaves lanceolate, acute, glabrous, up to $12 +$ cm. in length and $3.5 +$ cm. in width, diminishing gradually to floral bracts; inflorescence terminal, subspicate, $8 \pm$ cm. long, $4 \pm$ cm. broad; flowers numerous, greenish, rather closely approximate on thickened, glabrous pedicels $15 \pm$ mm. in length, including the ovulary; floral bracts lanceolate, acuminate, 1-veined, subequal to the pedicel and ovulary; sepals 3-veined, broadly ovate, 10 mm. in length, mucronate, the upper one somewhat concave; petals entire, 3-veined, nearly as long as the sepals, broadly ovate, inequilateral at the base; labellum $10 \pm$ mm. long, 3-parted, the divisions linear, nearly equal in length or the middle division slightly longer; spur $15 \pm$ mm. long; column short, $3 \pm$ mm. in height, including anther; staminodia conspicuous, one on each lateral face of the column, rugose punctate, curved slightly inward over each side of the anther, the tissues stored with clustered raphides of calcium oxalate; rostellum attached to the upper edge of the mouth of the spur, the middle lobe broadly triangular-obtuse, $2 \pm$ mm. in height, projecting upward between the free acute ends of the anther-thecae, the two lateral lobes of the same height, oblong, rolled closely partly around the acute end of the anther-theca directly above it; pollinia 2, broadly ellipsoidal, 2 mm. in length, each composed of 2 plano-convex, coarsely granular pollen masses attached to a slightly longer filiform caudicle, at the end of which is secreted a beadlike globule of glutinous liquid; stigmatic processes, free, smooth, acute, 1 mm. in length.

Marquesas, Uapou, altitude $700 \pm$ meters, September 13, 1922, Jones, no. 1190, type.

Closely allied to *H. tahitensis*, from which it is readily distinguished by (1) the smaller size of the leaves; (2) the stem, which is leaf-bearing throughout; (3) the entire petals; (4) the short spur; (5) the short stigmatic processes; and (6) the longer floral bracts.

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PLATE LEGENDS

PLATE I.—GRAMINEAE.

A, Rhapsis aciculata, showing mechanism for seed dispersal: *a*, at time of flowing; *b*, at time of maturity when the fertile spikelet bearing the ripe seed separates from the panicle; *ps*, pedicellate staminate spikelet; *ss*, sessile carpellate spikelet; *ct*, sharp pointed cleavage tissue; *aw*, awn; *pd*, pedicel; *B, Erianthus pedicellaris*; *C. Coix lachryma jobi*: *cf*, carpellate flowers enclosed in woody beadlike capsule; *sf*, staminate flowers; *D, Miscanthus japonicus*; *E. Erianthus pedicellaris* var. *rapensis*: *a*, ovulary; *b*, palea; *c*, anthers; *d*, first (outer) glume; *e*, second glume; *f*, third glume; *g*, fourth glume.

PLATE II.—GRAMINEAE.

Ischaemum stokesii: *a*, glume number 1, sessile spikelet; *b*, glume number 3, sessile spikelet; *c*, glume number 2, sessile spikelet; *d*, caryopsis with persistent styles and stigmas; *e*, glume number 4, sessile spikelet; *f*, palea of glume number 4; *g*, inflorescence; spikes forcibly spread apart for illustration; erect in type specimen (*ped*, pedicellate [terminal] spike; *ses*, sessile [lateral] spike); *h*, palea of glume number 3; *j*, sessile spikelet (*pd*, pedicel of pedicellate spikelet; *ra*, disarticulated internode of rachis); *k*, cross section of diagram of sessile spikelet: *gl 1*, glume number 1; *gl 2*, glume number 2; *gl 3*, glume number 3; *gl 4*, glume number 4; *pa 1*, palea of glume number 3; *pa 2*, palea of glume number 4; *fl 1*, inferior flower; commonly does not mature; *fl 2*, superior flower, commonly fertile.

PLATE III.—GRAMINEAE.

Pennisetum henryanum: *a*, mature spike; *b*, fascicle; *c*, first (lower) glume; *d*, second glume, *e*, third glume, inferior flower; *f*, palea, inferior flower; *g*, third glume of superior flower; *h*, palea of superior flower; *i*, stigma.

PLATE IV.—GRAMINEAE.

A, Pennisetum simeonis var. *intermedium*: *a*, palea and ovulary; *b*, fascicle; *c*, second glume; *d*, first (lower) glume; *e*, third glume; *B, Pennisetum articulare*: *a*, fascicle; *b*, first (lower glume); *c*, second glume; *d*, third (flowering) glume of inferior flower; *e*, third (flowering) glume of superior flower; *f*, palea; *g*, ovulary; *h*, stamens.

PLATE V.—GRAMINEAE.

A, Pennisetum marquisense: *a*, fascicle; *b*, diagram of spikelet X two scale; *c*, section from base of inner involucre bristle of *Pennisetum simeonis* var. *pedicellatum* to scale, showing the few plumose hairs; *d*, third glume; *e*, second glume; *f*, first glume; *gl 1*, first glume; *gl 2*, second glume; *gl 3*, third glume; *B, Oplismenus compositus* var. *pubescens*: *a*, spikelet to scale; *b*, diagram of spikelet enlarged twice the scale [the third glume (morphologically the inferior floral glume) envelops both the vestigial flower (*vf*) and the fertile flower (*ff*)]; *C, Panicum prostratum* var. *marquisense*: *a*, spikelet; *b*, diagram of spikelet; *ff*, fertile flower; *vf*, vestigial flower; *D, Panicum maximum*: *a*, spikelet; *b*, floral diagram.

PLATE VI.—GRAMINEAE (NON-ENDEMIC).

A, Aristida subspicata to scale; *B, Syntherisma pruriens*: *a*, diagram of spikelet; *b*, portion of raceme showing sessile and pedicellate spikelets; *C, Paspalum distichum*; *D, Paspalum paniculatum*: *a*, arrangement of spikelets on branches of panicle; *b*, diagram of spikelet.

PLATE VII.—GRAMINEAE.

Syntherisma pelagica: *a*, inflorescence composed of nine \pm closely appressed erect spikes, var. α ; *b*, portion of spike, var. β ; *c*, spike, var. α ; *d*, flowering spikelet, var. α ; *e*, cross section diagram of spikelet, var. α (gl 1 to gl 4, glumes); *f*, portion of spike, var. γ ; *g*, caryopsis, var. α .

PLATE VIII.—GRAMINEAE.

Agrostis rapensis: *a*, ligule (junction of leaf blade with the sheath); *b*, caryopsis; *c*, Abbe camera drawing of ovary bearing two stigmas in the early stages of development; *d*, Abbe camera drawing of apex of flowering glume; *e*, Abbe camera drawing of mature stigma with pollen grain attached; *f*, spikelet; *g*, spike and uppermost leaf blade. (Drawing of *a* from Stokes no. 309, *b-f* from type specimen, Stokes no. 342.)

PLATE IX.—GRAMINEAE.

A, *Eragrostis xerophila*: *a*, stem; *b*, spikelet; *c*, palea; *d*, floral glume; *li*, ligule sheath; *la*, convolute lamina of leaf; *B*, *Eragrostis marquisensis*: *a*, spikelet with florets slightly spread apart; *b*, palea (opened) two-veined, ciliate; *c*, three-veined floral glume with ciliate margin; *C*, *Centotheca lappacea*: *sf*, superior floret; *if*, inferior floret; *gl*, empty glumes; *rh*, rachis; *D*, spikelet diagrams of non-endemic *Chlorideae*: *a*, *Capriola* (*Cynodon*) *dactylon*; *b*, *Eleusine indica*; *c*, *Dactyloctenium aegyptiacum*, inferior floret.

PLATE X.—CYPERACEAE.

A, *Cyperus feani* slightly reduced; *a*, spikelet, *b*, single flower with achene (*ac*): *rh*, rachis; *wi*, wings of rachis; *B*, *Cyperus pennatus*: *a*, spikelet to scale; *b*, inflorescence; *C*, *Cyperus marquisensis*: *a*, inflorescence; *b*, spikelet; *fg*, fertile glume with achene (*sg*) partly contained in the hyaline wings (*ac*) of the rachis; *sg*, sterile apical glumes covering apex of rachis; *D*, *Cyperus moutona*, showing spikelet to scale: *sg*, sterile basal glumes which persist for a time after the fall of the remainder of the spikelet; *fg*, fertile glumes.

PLATE XI.—CYPERACEAE (CYPERUS FEANI).

A, inflorescence to scale; *B*, diagram (reduced) scale of sub-umbellate cluster, showing mode of branching. The secondary rays (1-6) are spirally arranged with an angular divergence of 120 degrees, and are unbranched; the short rays (4-6) are spicate throughout.

PLATE XII.—CYPERACEAE (R[H]YNCHOSPORA MARQUISENSIS).

A, axis of spikelet, to scale; *B*, panicle; *C*, anthers from unopened terminal flower, to scale; *D*, flower, after fall of anthers, to scale: *br*, hypogynous bristles; *fi*, filament; *nt*, nutlet at maturity; *st*, two-parted style; *E*, cross section diagram of spikelet, enlarged, not to scale; *fl* 1, first flower (lateral); *fl* 2, second flower (lateral); *fl* 3, third flower (terminal); *gl* 1-*gl* 9, glumes as shown in *G*; *F*, spikelets: *br*, hypogynous bristle, exerted; *fi*, filament, exerted, from which the anther has fallen; *st*, two-parted style, exerted; *G*, glumes from spikelet, to scale: 1, first (basal) glume, sterile; 2, second glume, sterile; 3, third glume, sterile; 4, fourth glume, sterile; 5, fifth glume, sterile; 6, sixth glume, fertile; 7, seventh glume, sterile; 8, eighth glume, fertile; 9, ninth glume, fertile.

PLATE XIII.—CYPERACEAE.

A, *Cladium nukuhivense*: *a*, achene with persistent filaments; *b*, inflorescence $\times 1/10$ scale; *c*, longitudinal section of leaf showing chambered cavities enlarged; *d*, outer scale of spikelet; *e*, anther; *B*, *Cladium meyenii*: *a*, achene with persistent filaments (the pubescent thickened base of the style persists forming a prominent beak of the achene); *b*, branch of panicle showing clustered arrangement of spikelets.

PLATE XIV.—CYPERACEAE.

A, Gahnia stokesii: *a*, basal glume; *b*, fourth glume; *c*, (inner) sixth glume; *d*, flower; *e*, fruit; *B, Eleocharis caribaea* var. *stokesii*: *a*, glume; *b*, flower; *c*, fruit; *d*, oblique opening of inner sheath; *C, Cyperus rapensis*, showing spikelet with two empty basal glumes, two fertile glumes, and three sterile apical glumes.

PLATE XV.—CYPERACEAE.

A, Gahnia marquisensis: *a*, second scale; *b*, third scale; *c*, involucre bract at base of spikelet; *d*, first (outer) scale or glume; *e*, anther; *f*, portion of panicle $\times 1/5$ scale; *g*, fourth (inner) scale; *h*, achene with persistent filaments and deciduous style; *B, Carex faeni*: *a*, scalelike glume of staminate flower; *b*, caespitose base sketched to scale of *c*; *c*, perigynium containing an achene, the two branches of the style exerted; *d*, scalelike glumes of carpellate flower; *e*, inflorescence of racemose spikes, each of which is carpellate in the lower cylindrical portion and staminate in the contracted apical extension.

PLATE XVI.—ARACEAE CULTIVATED BY THE MARQUESANS.

A, Cyrtosperma merkusii to scale: *a*, marginal venation enlarged; *B, Colocasia antiquorum* var. *esculenta* to scale: *a*, marginal venation enlarged; *C, Alocasia macrorrhiza* to scale: *a*, marginal venation enlarged; *D, Xanthosoma atrovirens* to scale: *a*, marginal venation enlarged; *E, Typhonium trilobatum* to scale: *a*, marginal venation enlarged.

PLATE XVII.—MARQUESAN ORCHIDS.

A, Liparis clypeolum var. *atahi*: *a*, anther; *c*, column with two alae (*al*); *l*, labellum; *p*, petal; *po*, two paired masses of pollen; *s*, sepals; *B, Calanthe tahitensis* var. *marquisensis*, showing side view of flower, face view of flower, and pollinia; *C, Habenaria tahitensis*: *a, b*, pollinia; *c*, linear petal to which a pollinium (*po*) has become glued; *d*, oral opening of spur; *e*, lateral lobe of rostellum rolled partly around the acute end of the anther theca; *f*, globule of glutinous liquid secreted at the distal end of the caudicle of the pollinium; *g*, theca of anther containing the pollinium; *h*, middle lobe of rostellum; *k*, labellum; *l*, lateral petal; *m*, upper concave sepal; *n*, lower spreading sepal; *o*, stigmatic process; *p*, staminodium; *D, Habenaria marquisensis*, legend as in *C*.

PLATE XVIII.—MARQUESAN ORCHIDS.

A, Calanthe tahitensis var. *marquisensis*; *B, Habenaria marquisensis*; *C, Habenaria tahitensis* var. *falcata*.

PLATE XIX.—FREYCINETIA (TYPE SPECIMENS).

A, Freycinetia monticola showing staminate inflorescence and rosette of orange-colored bracts; *B, Freycinetia marquisensis* in fruit.

PLATE XX.—PANDANUS MEI.

Type plant with type fruit tied to the brace roots (lower left corner).

PLATE XXI.—PANDANUS (TYPE SYNCARPIA).

A, Pandanus mei, tied to brace roots of type plant; *B, Pandanus tectorius* var. *taepa*, with one drupe removed.

PLATE XXII.—GRASS ASSOCIATIONS, WESTERN NUKUHIVA.

A, Rhaphis aciculata, one of the most valuable pasture grasses of the prairie region. The climax in the turf association is formed by *Panicum prostratum* var. *marquisense*, which occupies the submesophytic parts of this region; *B*, arid prairie (*henua ataha* or *fenua ataha*) of western Nukuhiva, covered by tussocks of *Aristida subspicata* (*pavaohina*).

PLATE XXIII.—GRAMINEAE AND CYPERACEAE.

A, *Saccharum officinarum*, a variety with leaves variegated white and green in longitudinal stripes, cultivated by the ancient Marquesans; *B*, *Saccharum officinarum* growing under native methods of cultivation in Taipi Vai, Nukuhiva. This variety is known as *to ma'oi*. *C*, *Miscanthus japonicus*, growing at an altitude of 600 meters in the interior of Nukuhiva; *D*, *Cladium nukuhivense*, covering a former lake now filled with peat, Tovii, Nukuhiva, altitude 1,000 meters. This plant is gregarious and forms a sharp line of tension with the encroaching vegetation of the foreground, which is composed chiefly of *Gleichenia dichotoma* and *Lycopodium cernuum*. This bog, known as Moku-au-toto to the natives, is evidently a relic of a cold climate flora.

PLATE XXIV.—MARQUESAN COASTAL VEGETATION.

A, coastal cliffs, Hakau, Nukuhiva, covered with *Pennisetum* and *Eragrostis*. *Pennisetum articulare* is the most xerophytic species, and predominates on the vertical walls shown in the central part of the photograph. The less xerophytic *Pennisetum simeonis* occurs on the more gradual slopes in the foreground. *Eragrostis xerophila* grows in association with *Pennisetum articulare*. *B*, Tussocks at close range. *Pennisetum simeonis* forms the two tussocks in the upper right hand central part of the view. The left tussock and the four in the lower foreground are composed of *Eragrostis xerophila*.

PLATE XXV.—PALMAE.

A, *Pritchardia pacifica* var. *marquensis* inflorescence at left; panicle of fruits at right material from Hakapuuvae, Nukuhiva; *B*, native variety of coconut having small fruit with a conical protuberance at apex; native name, *ehi mamaemoa*; *C*, coconut growing in Taipi Vae, Nukuhiva, in flower and fruit six years after planting.

PLATE XXVI.—PELAGODOXA HENRYANA Beccari.

A, leaf; petiole at left; flowering spadix at right with single fruit in section and three fruits attached; all from type tree at Taipi Vai, Nukuhiva; *B*, tree at Puamau, Hivaoa; coconut in right background; *C*, fruits from type tree at Taipi Vai, Nukuhiva; same as *A*, but enlarged.

PLATE XXVII.—VARIETIES OF TARO (COLOCASIA ANTIQUORUM) CULTIVATED BY THE MARQUESANS.

A, *ta'o poitere*; *B*, *ta'o paki*; *C*, *ta'o ma'oi*; *D*, *ta'o rapa*; *E*, *ta'o rehu*.

PLATE XXVIII.—MONOCOTYLEDONS OF ANCIENT INTRODUCTION.

A, *Curcuma longa*, flowers and leaf; *B*, *Hedychium flavum*; *C*, *Xanthosoma atrovirens*, one of the cultivated Araceae.

PLATE XXIX.—MONOCOTYLEDONS OF ANCIENT INTRODUCTION.

A, *Dioscorea bulbifera* L., from Brown no. 853, Nukuhiva; *B*, native pineapple; *C*, *Musa paradisiaca*, native variety known as *meika poupou*.

PLATE XXX.—VARIETIES OF CORDYLINE TERMINALIS CULTIVATED BY THE MARQUESANS.

A, *auti kopa*; *B*, *auti puhehe*.

PLATE XXXI.—VARIETIES OF CORDYLINE TERMINALIS CULTIVATED BY THE MARQUESANS.

A, *auti popoi*; *B*, *auti kua* (Nukuhivan form).

PLATE XXXII.—ORCHIDACEAE.

Liparis clypeolum var. *marquisensis*; inflorescence, fruits, dehisced capsules.

PLATE XXXIII.—NATIVE USES OF COCONUT LEAVES.

A, "kapu" sign made by Haapuane, well known kahuna of Atuona, Hivaoa; *B*, thatch, made by the natives of Hakau, Nukuhiva. It is three-ply in the sense that three leaflets are used in making each strand of the plaiting, instead of two leaflets as in Hivaoa.

PLATE XXXIV.—MARQUESAN TOPOGRAPHIC FEATURES.

A, view of mouth of Taipi Valley, Nukuhiva, showing invasion of sea and submergence of land at the mouth of the river. Photograph by Captain Harry Pidgeon, 1928 (Courtesy of the National Geographic Society); *B*, view of the Tovii region, Nukuhiva, showing rain forest associations with open areas covered mainly by *Gleichenia linearis*.

PLATE XXXV.—MARQUESAN TOPOGRAPHIC FEATURES.

A, crest of ridge, Uapou, showing spirelike rock covered with lichens; *B*, view taken in the interior of Tovii, Nukuhiva, showing Moku-au-toto, the largest bog association of the islands, in which the predominant plant (*Cladium nukuhivense*) forms a sharp line of tension with the invading foreground zone composed chiefly of *Gleichenia linearis*; *C*, view taken in the interior of Tovii, Nukuhiva, showing a crater lake (named Lac Henry, in honor of Monsieur Charles Henry, who discovered the rare Marquesan palm *Pelagodoxa henryana*) covered by invading rain forest vegetation.

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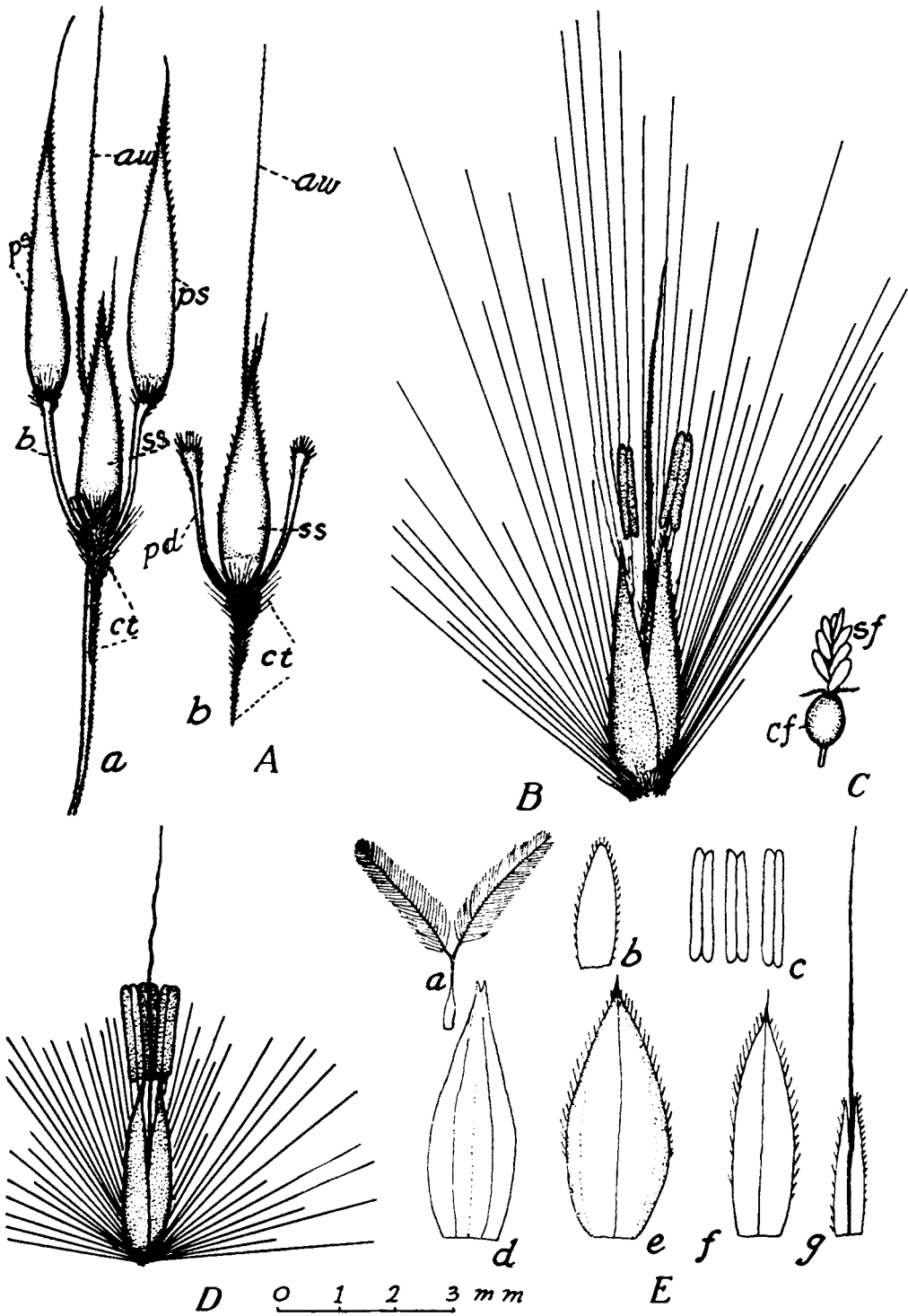
Includes synonyms (in italics) and families.

A, Austral Islands; M, Marquesas; R, Rapa; T, Tuamotus; 1, indigenous; 2, endemic; 3, aboriginal introduction; 4, modern introduction.

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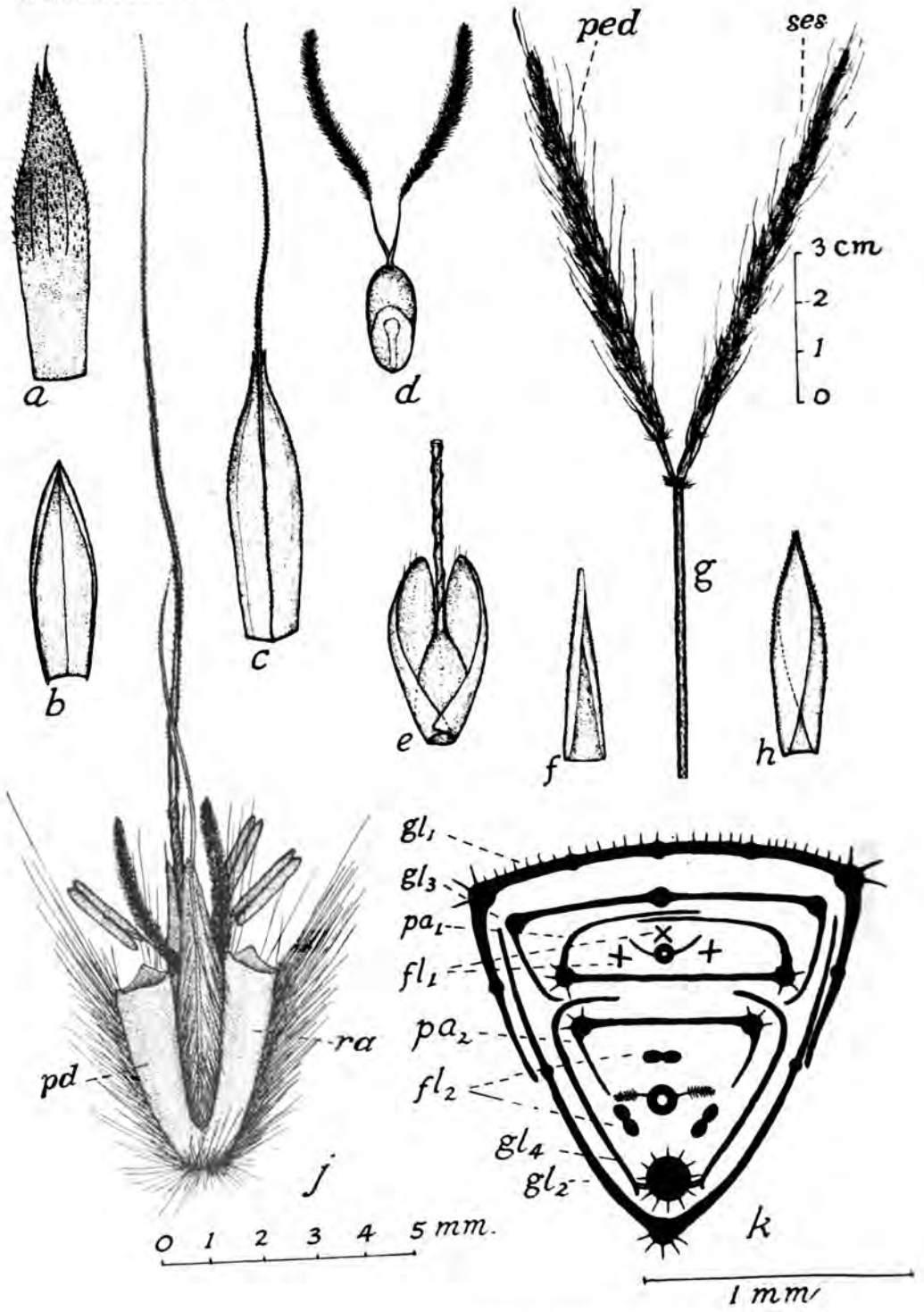
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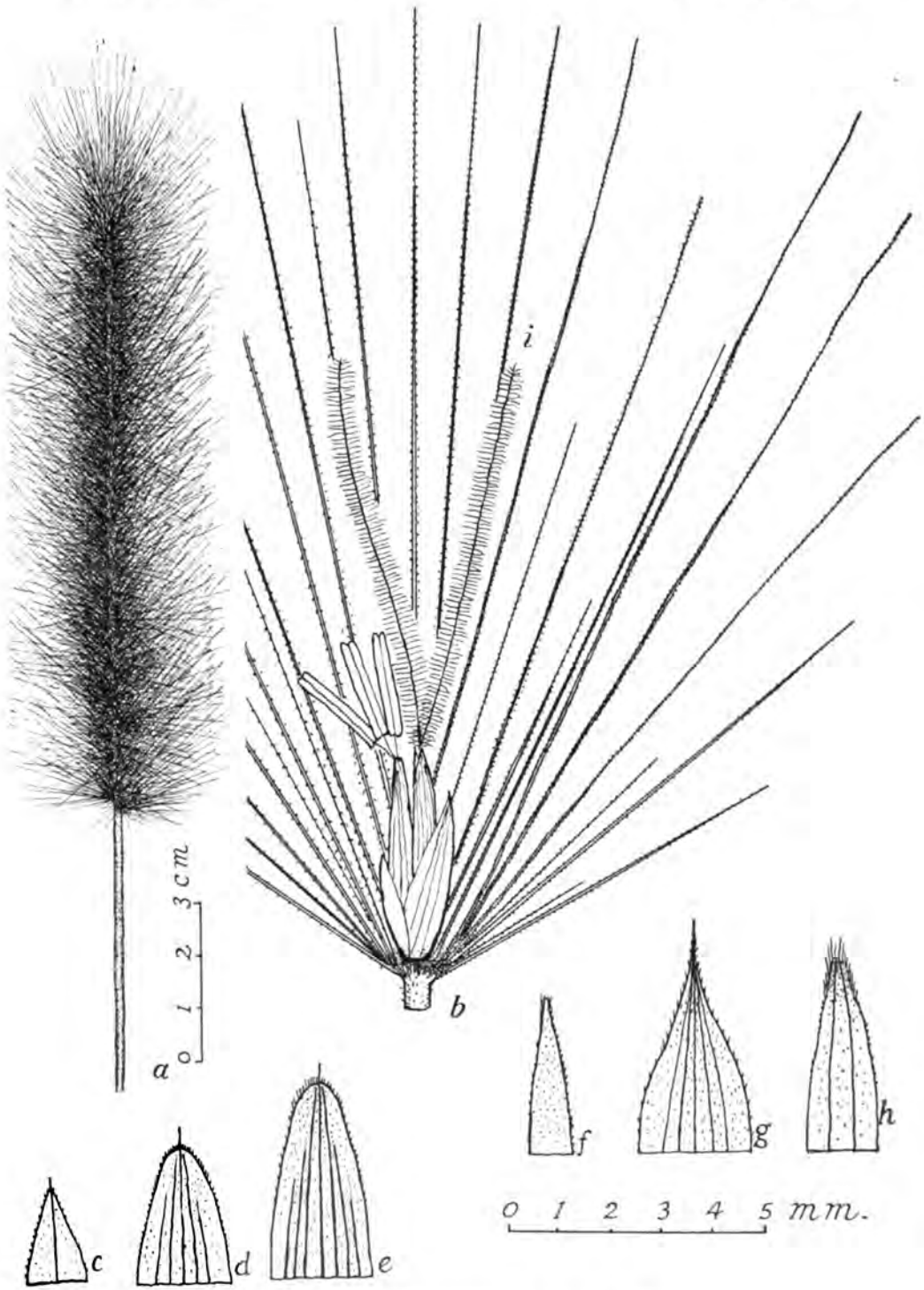
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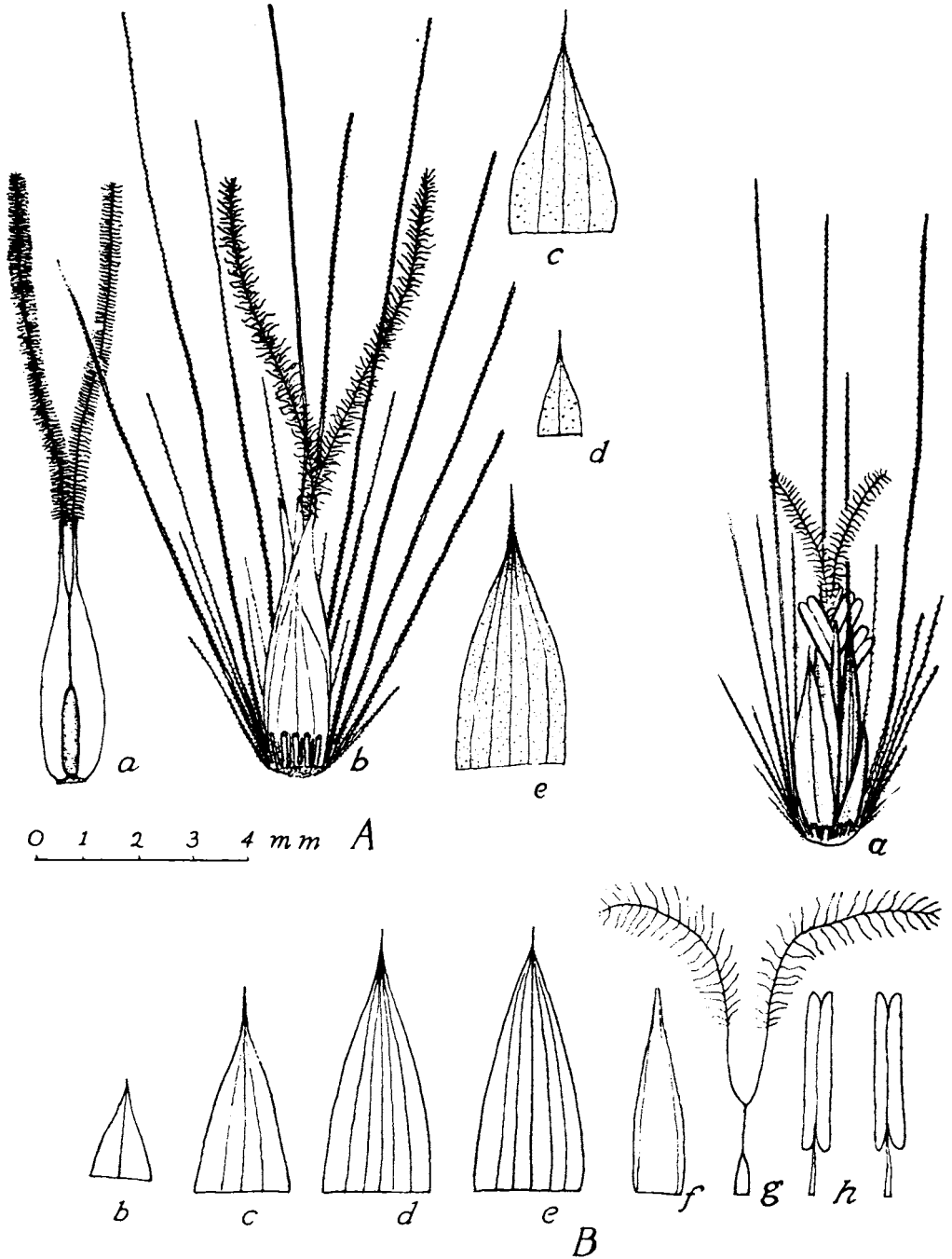
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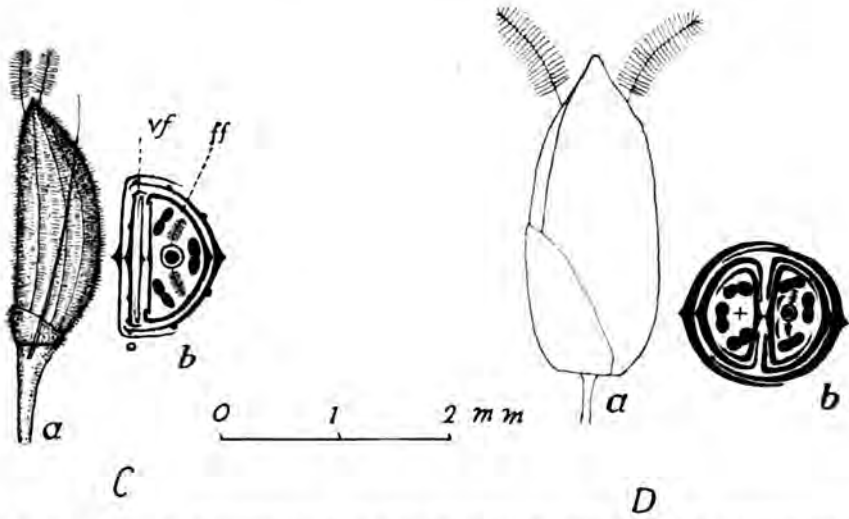
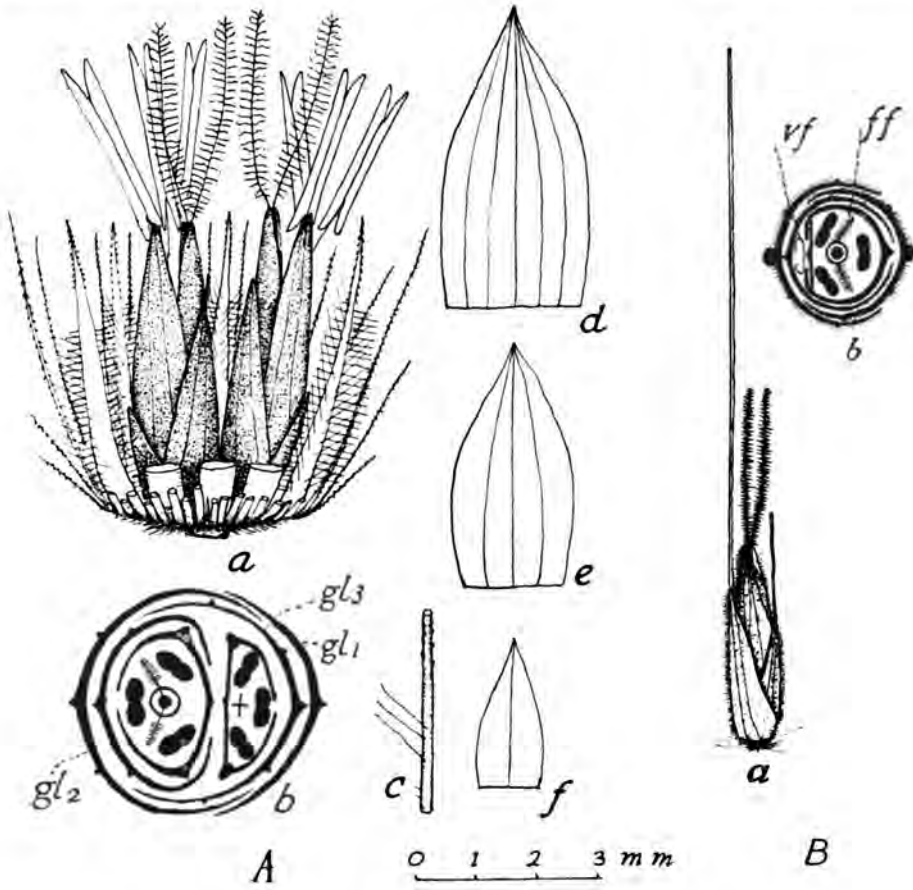
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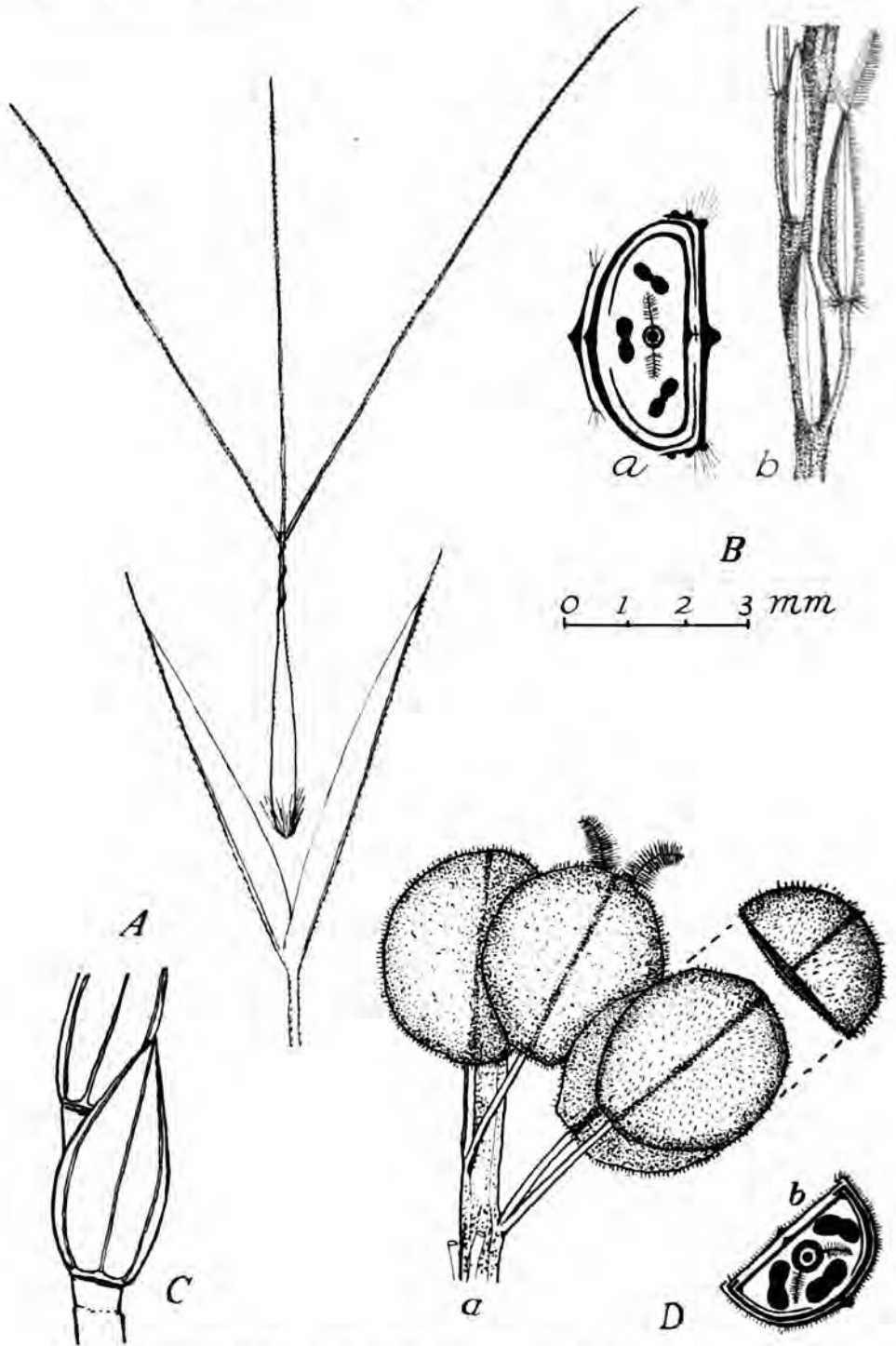
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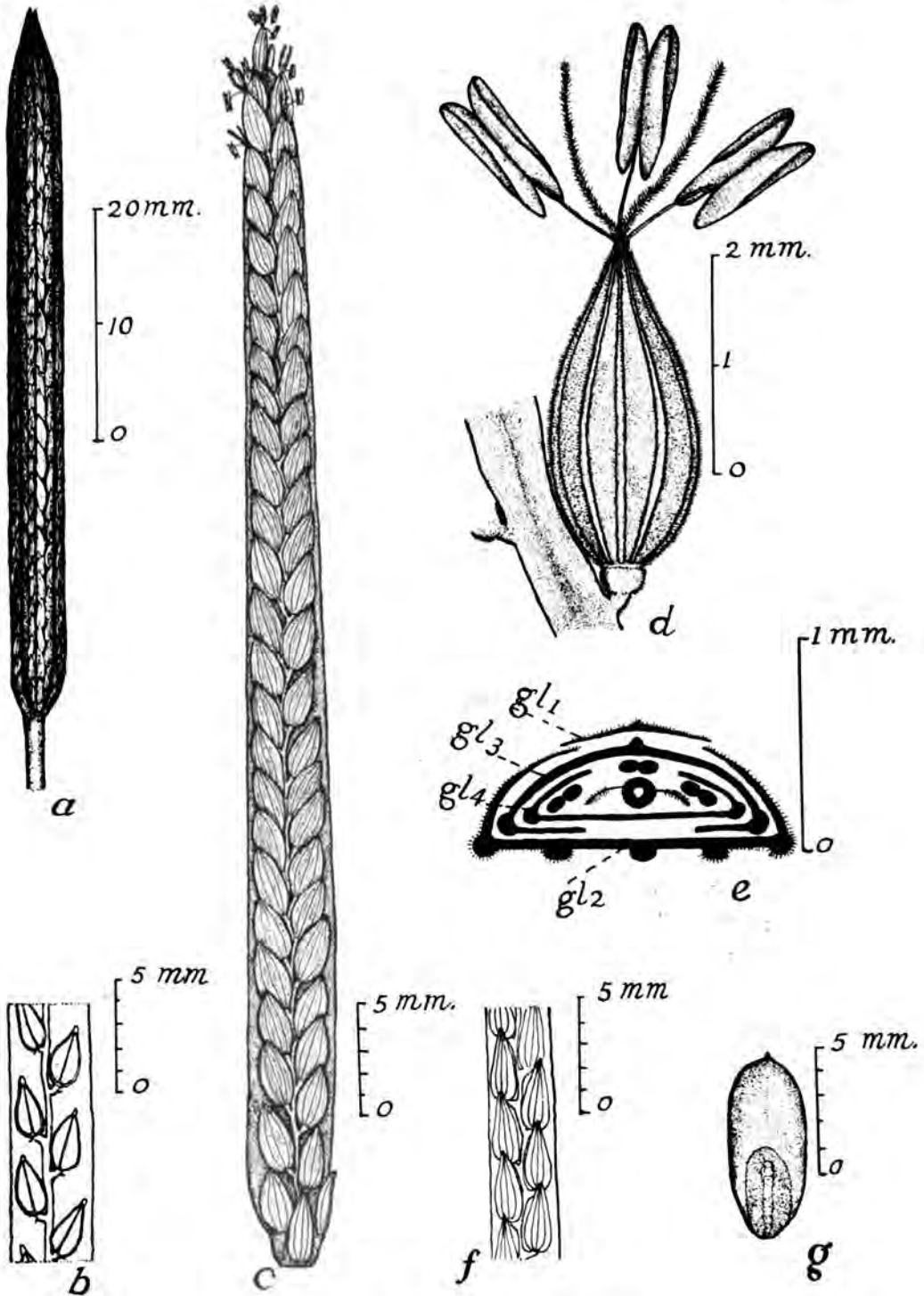
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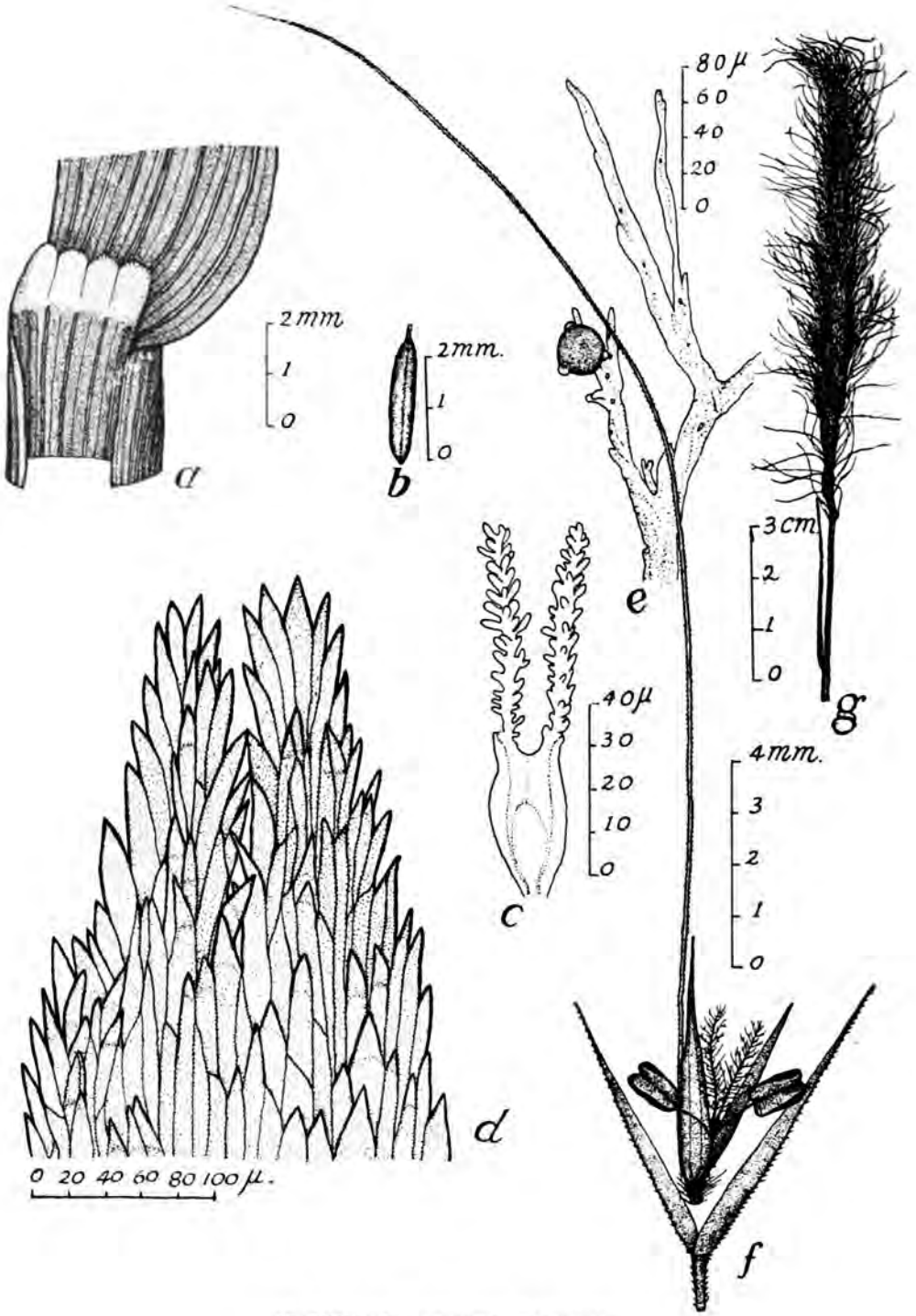
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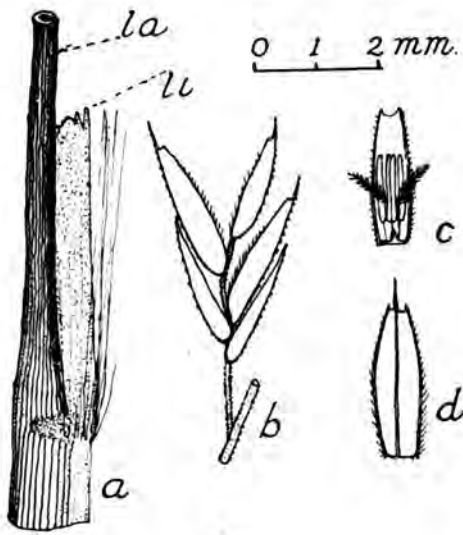
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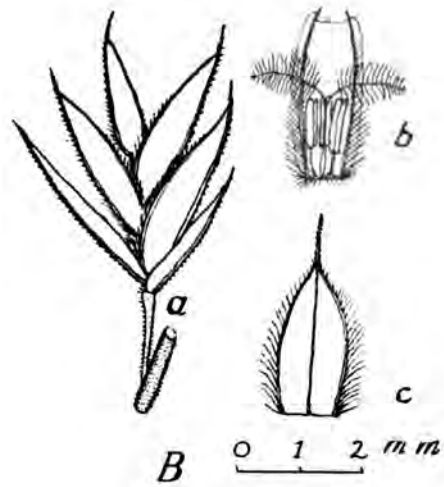


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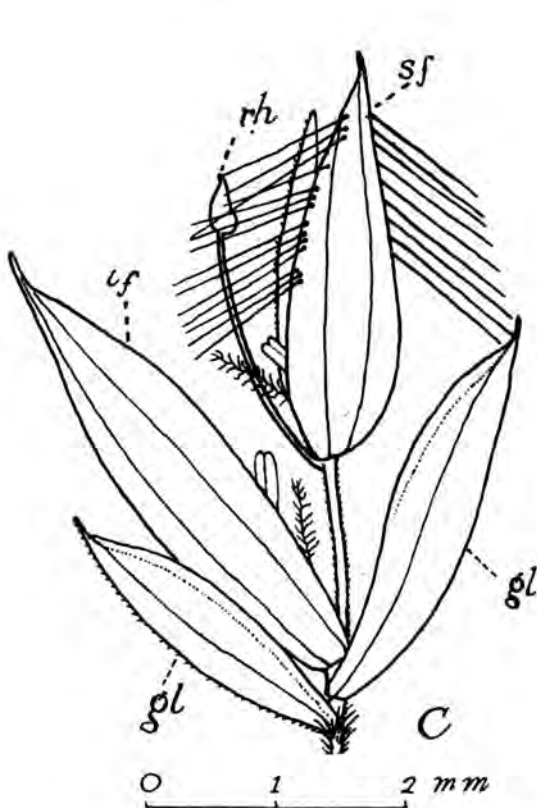
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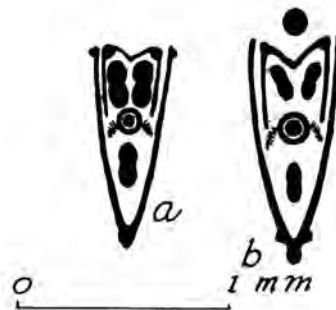
A



B



C



a

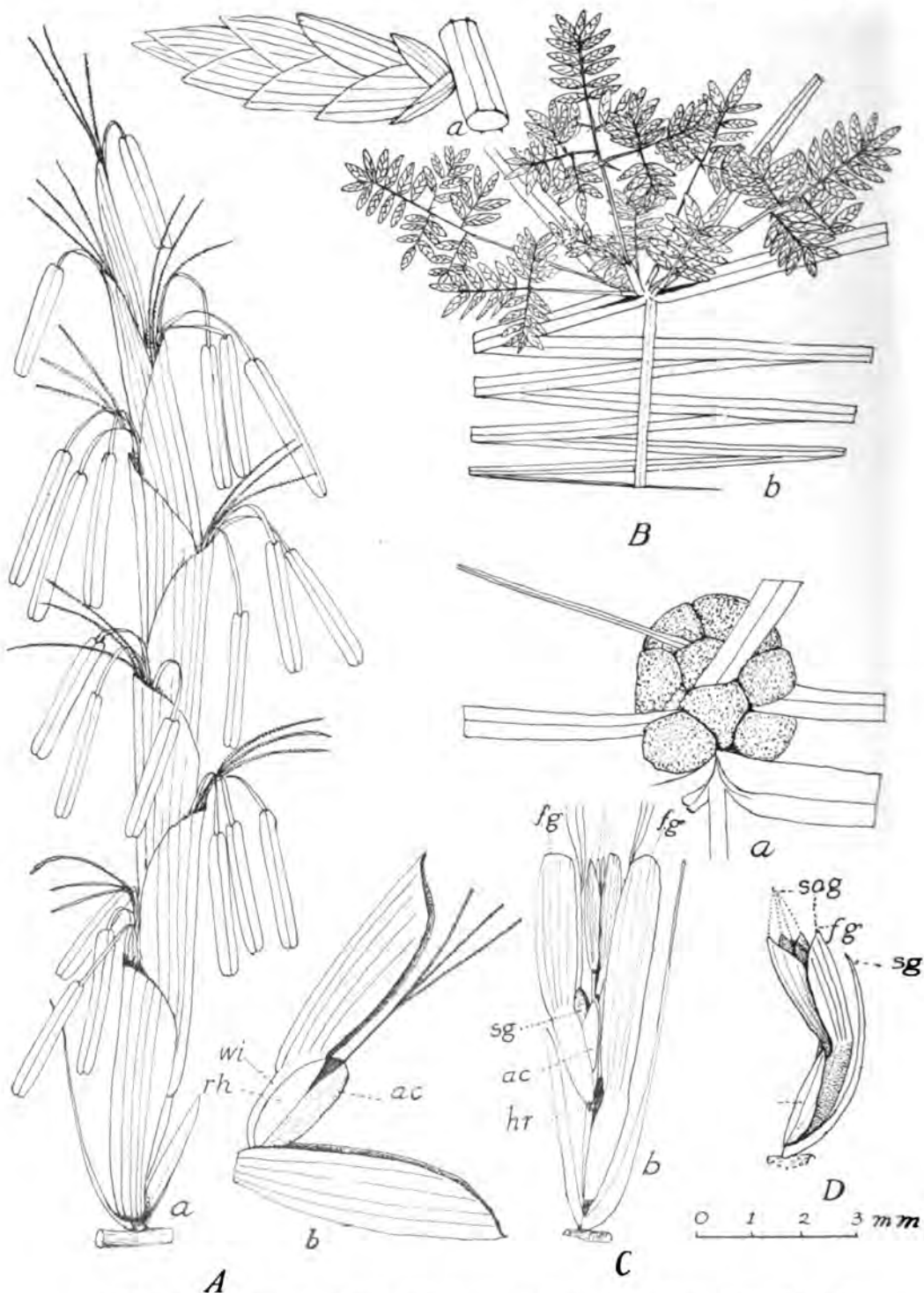
b

c

D

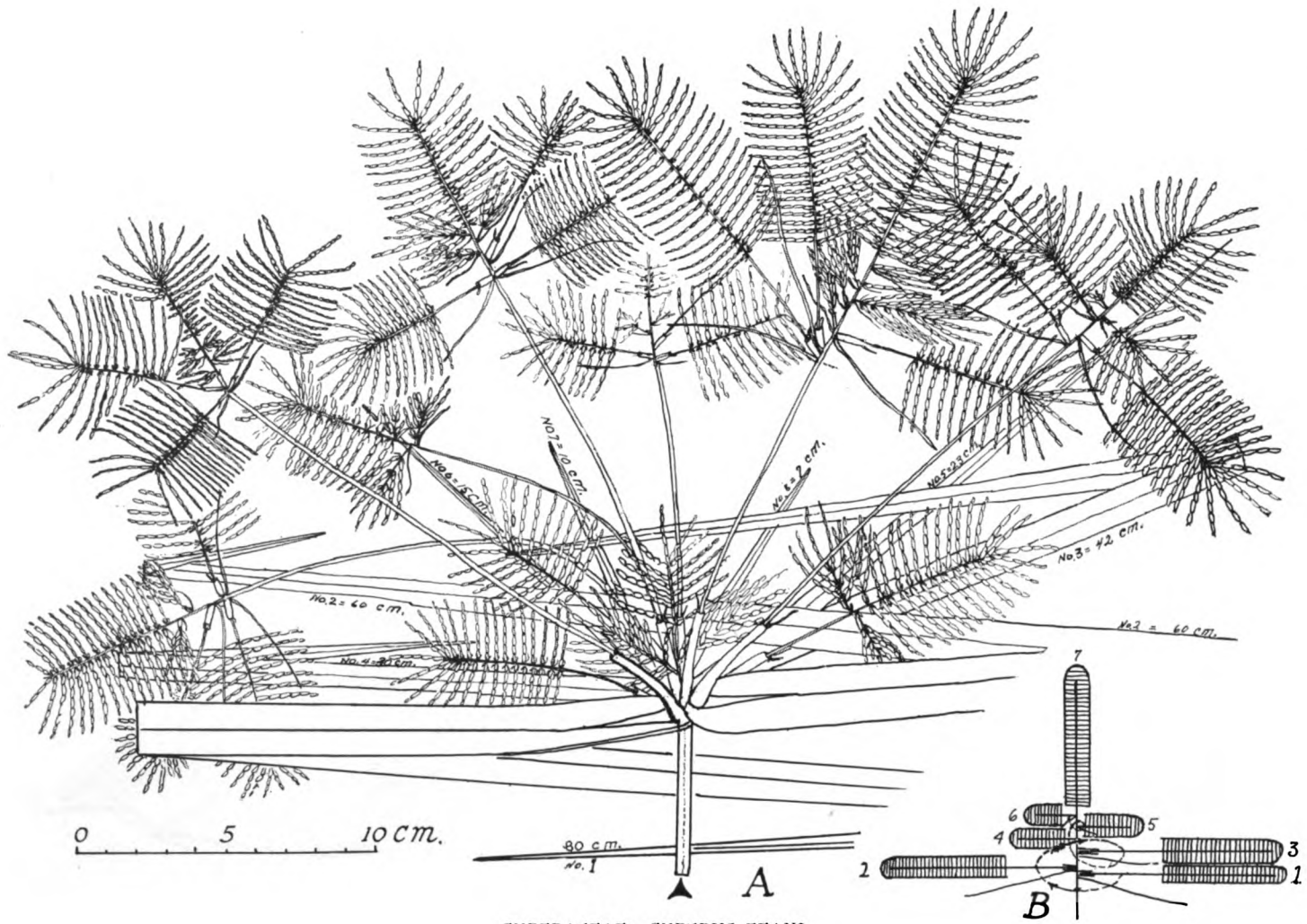
GRAMINEAE: A, ERAGROSTIS XEROPHILA; B, ERAGROSTIS MARQUISENSIS; C, CENTOTHECA LAPPACEA; D, SPIKELET DIAGRAMS OF NON-ENDEMIC CHLORIDEAE.

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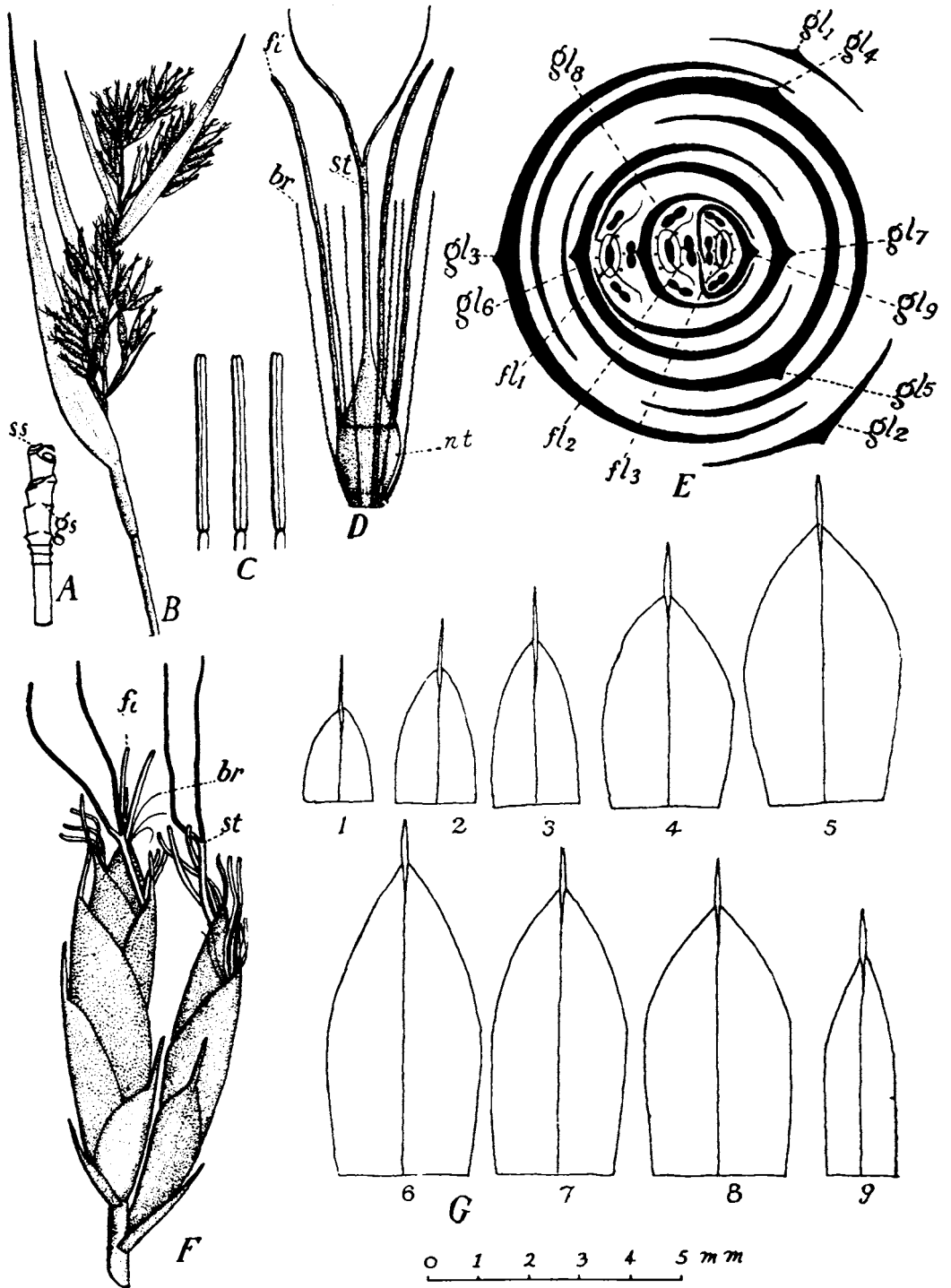


CYPERACEAE: A, CYPERUS FEANI; B, CYPERUS PENNATUS; C, CYPERUS MAR-
 QUISENSIS; D, CYPERUS MOUTONA.

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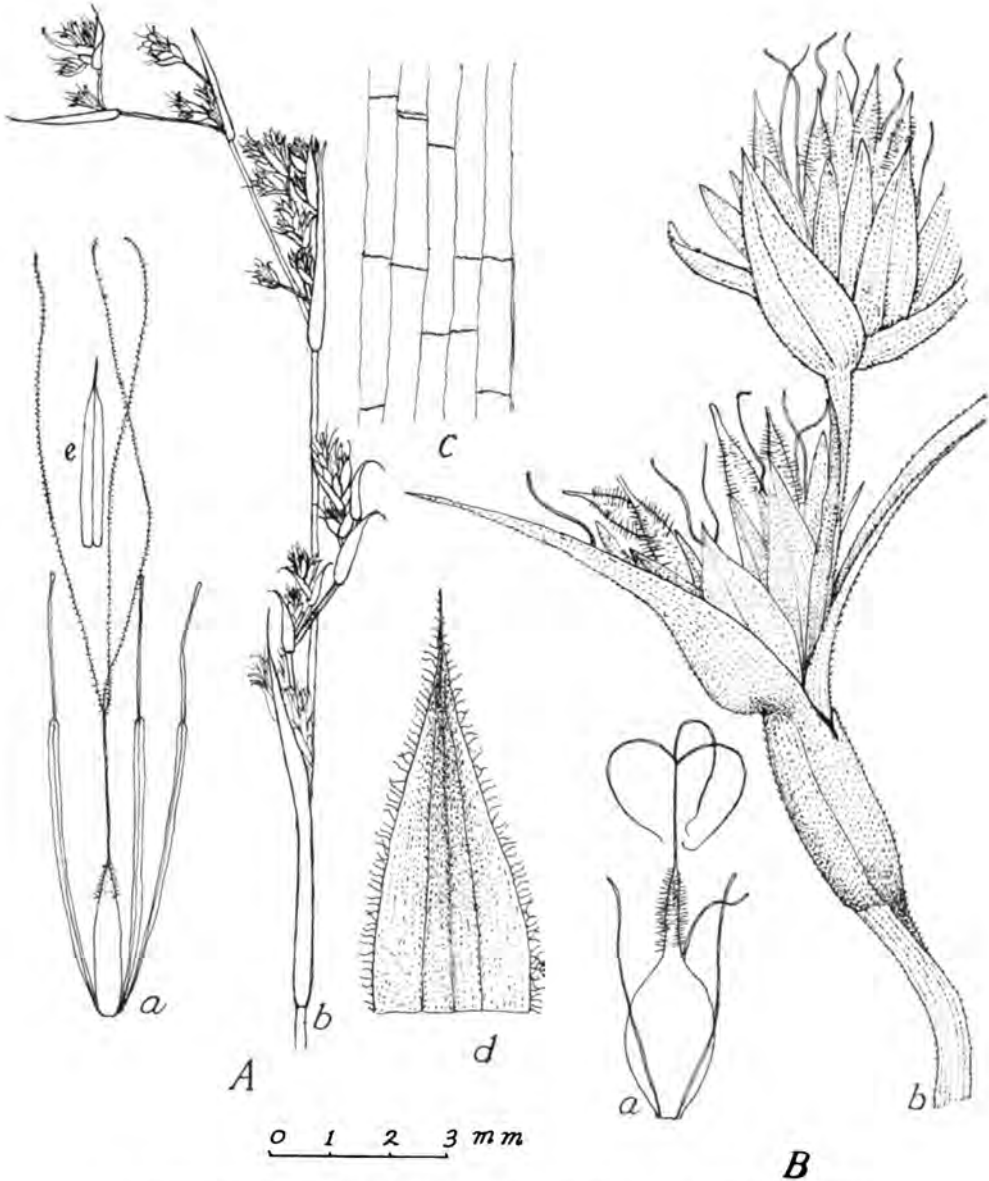
CYPERACEAE: CYPERUS FEANI.



0 1 2 3 4 5 mm

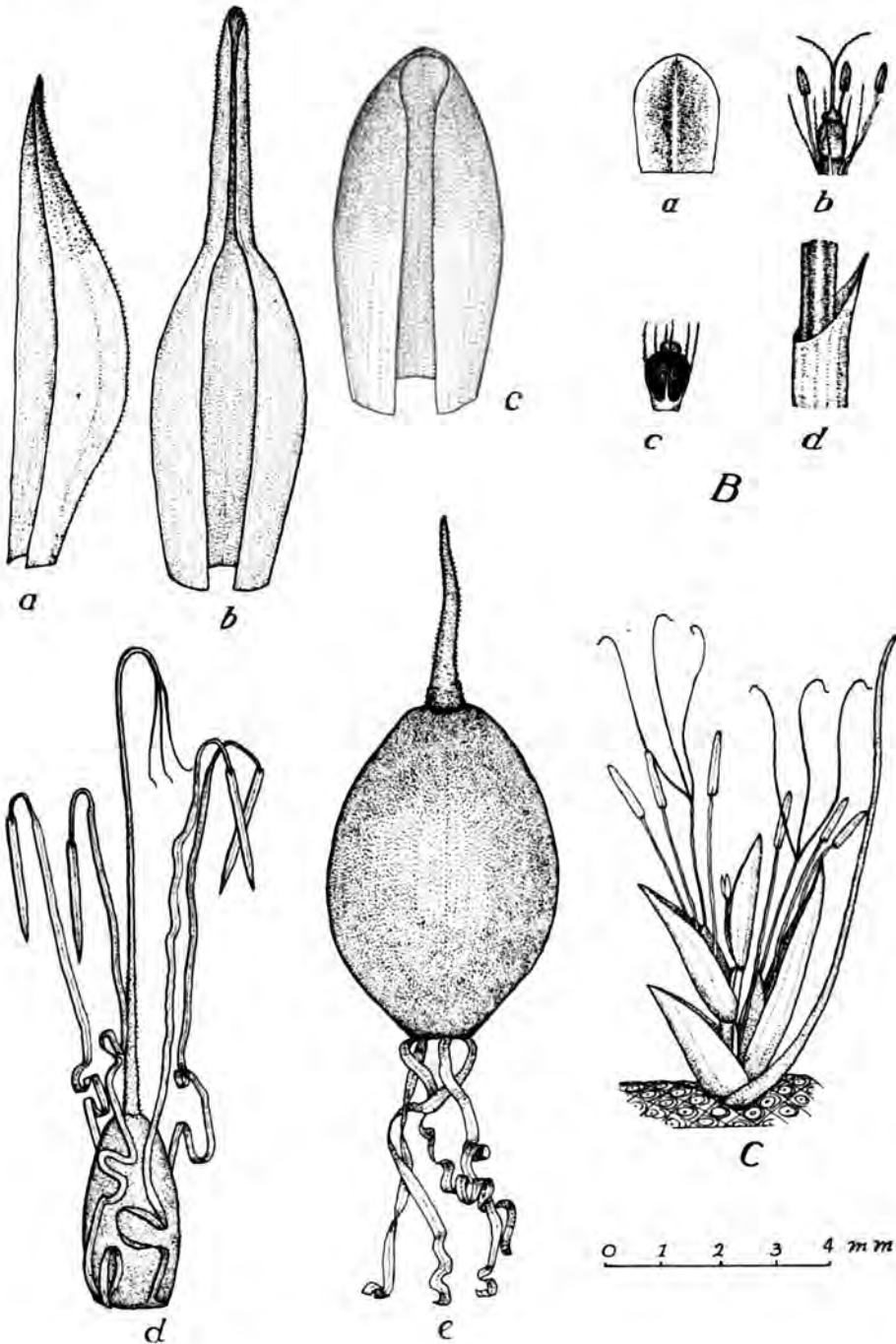
CYPERACEAE: R(II)DYNCHOSPORA MARQUISENSIS.

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CYPERACEAE: A, CLADIUM NUKUHIVENSE; B, CLADIUM MEYENII.

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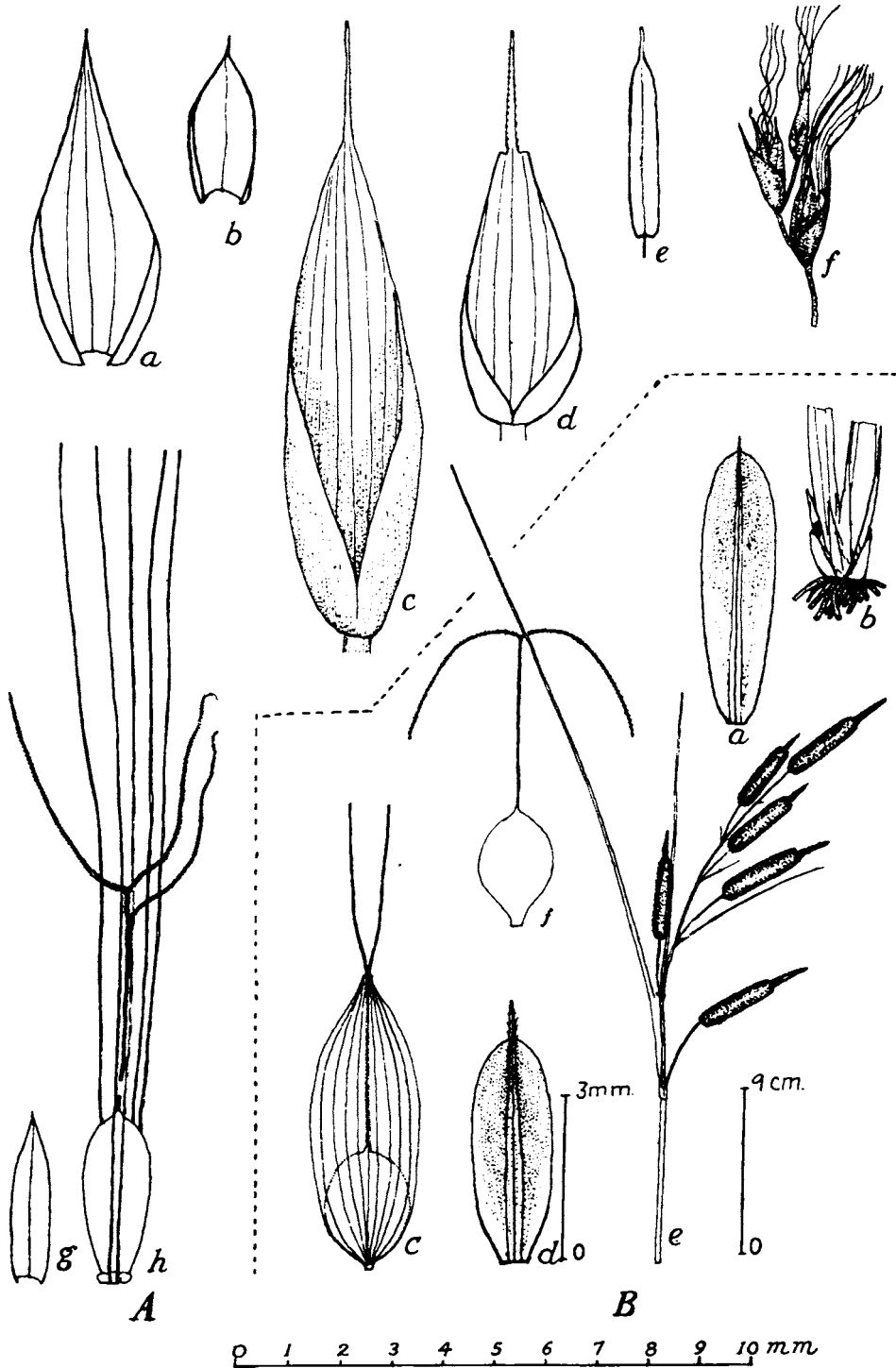


A

C

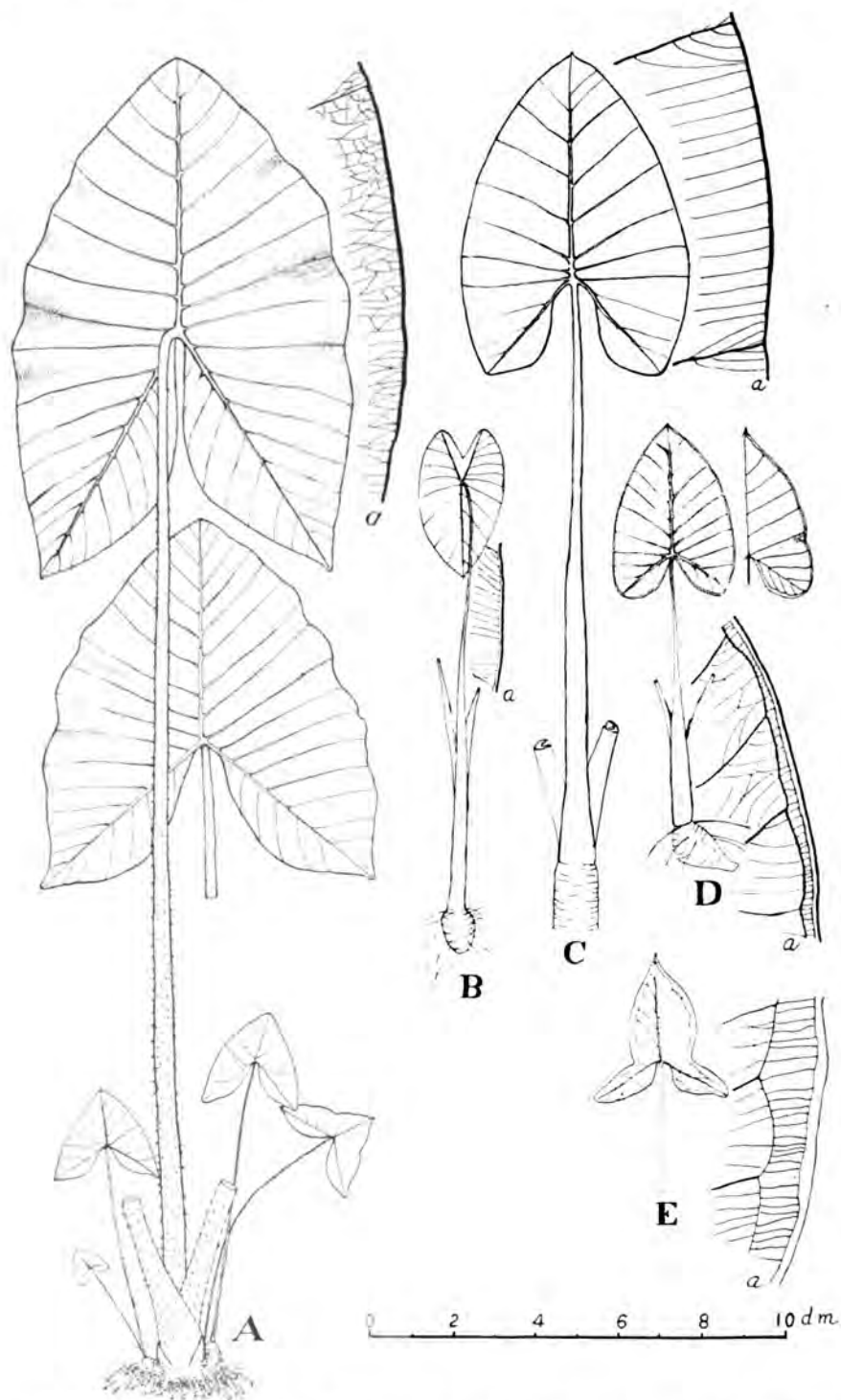
CYPERACEAE: A, CALYMNIA STOKESII; B, ELEOCHARIS CARIBAEA VAR. STOKESII; C, CYPERUS RAPENSIS.

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Public Domain, Google-digitized / http://www.hawaii.edu/access/usage-policy.html

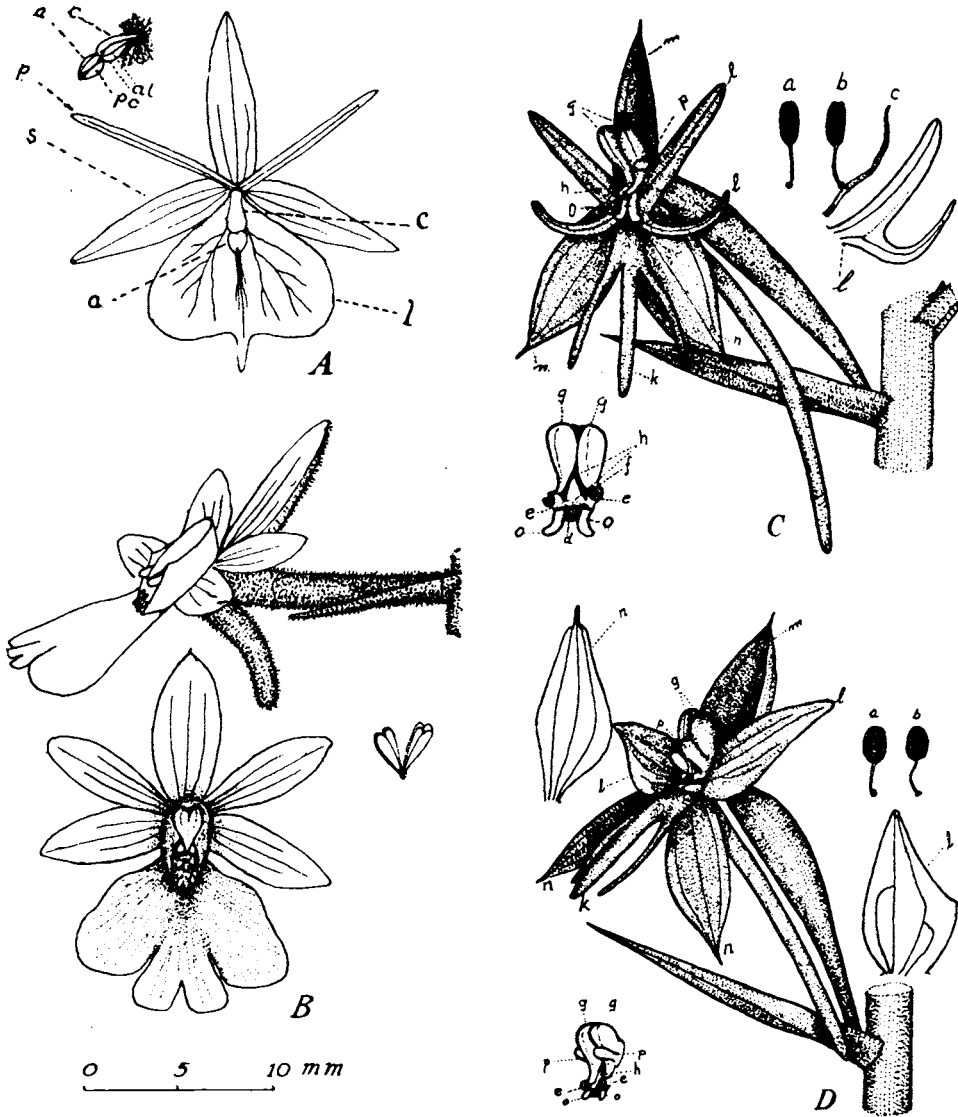


CYPERACEAE: A, GAHNIA MARQUIESFENSIS; B, CAREX FEANI.

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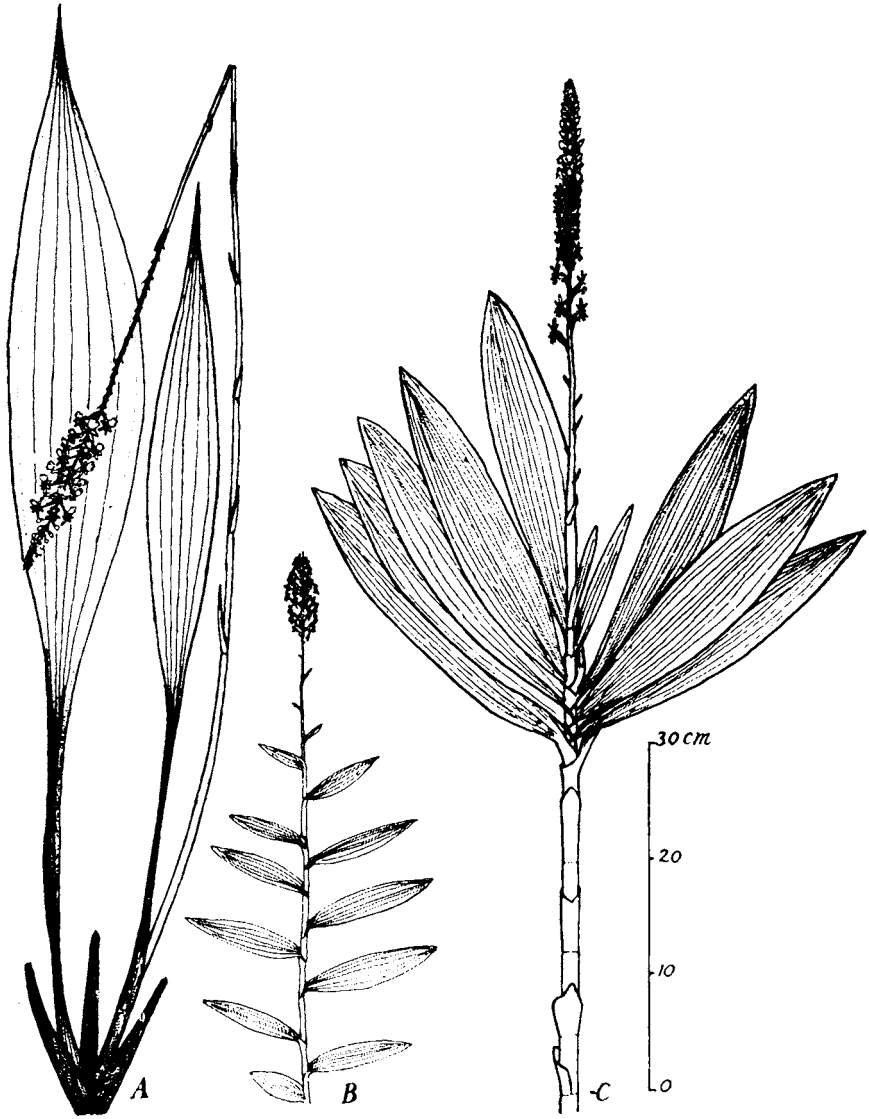


ARACEAE: A, *CYRTO SPERMA MERKUSII*; B, *COLOCASIA ANTIQUORUM* VAR. *ESCULENTA*; C, *ALOCASIA MACRORRHIZA*; D, *XANTHOSOMA ATROVIRENS*; E, *TYPHONIUM TRILOBATUM*.



MARQUESEAN ORCHIDS: A, *LIPARIS CLYPEOLUM* VAR. *AUTAHU*; B, *CALANTHE TAHITENSIS* VAR. *MARQUENSIS*; C, *HABENARIA TAHITENSIS*; D, *HABENARIA MARQUENSIS*.

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MARQUESAN ORCHIDS: A, *CALANTHE TAIHENSIS* VAR. *MARQUISENSIS*; B, *HABENARIA MARQUISENSIS*; C, *HABENARIA TAIHENSIS* VAR. *FALCATA*.

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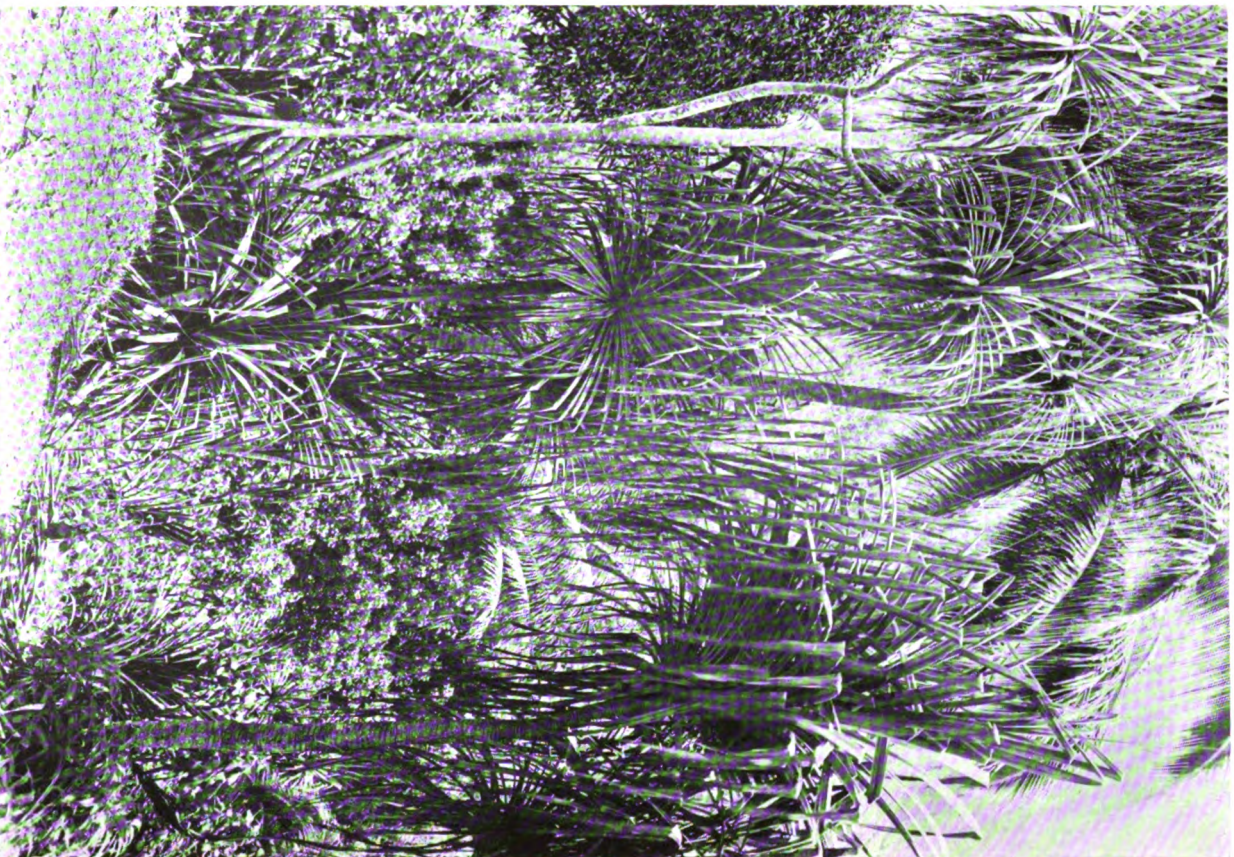


A



B

FREYCINETIA: *A*, FREYCINETIA MONTICOLA; *B*, FREYCINETIA MARQUISENSIS.

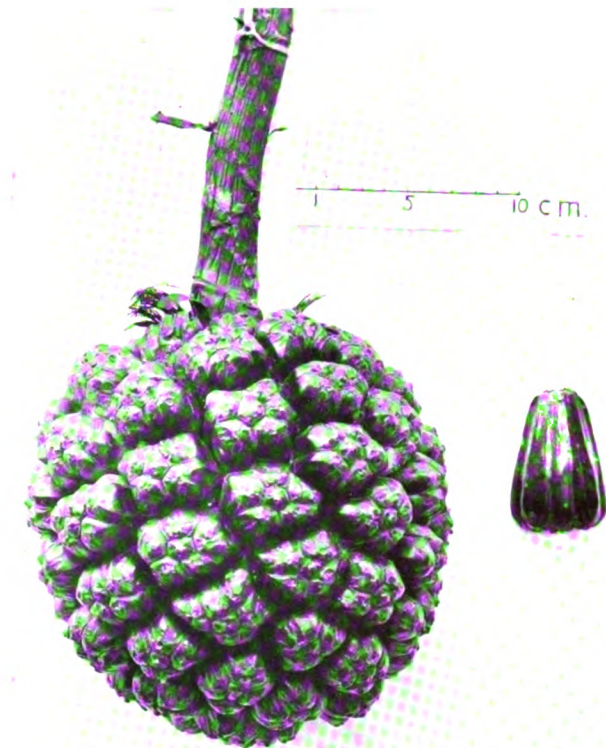


PANDANUS MELI.



A

PANDANUS: *A*, PANDANUS MEI; *B*, PANDANUS TECTORIUS VAR. TAEPA.



B



A



B

GRAMINEAE: A, RHAPHIS ACICULATA; B, ARISTIDA SUBSPICATA (PAVAOHINA).



A



B



C



D

GRAMINEAE AND CYPERACEAE: A, VARIETY OF *SACCHARUM OFFICINARUM*; B, *SACCHARUM OFFICINARUM*; C, *MISCANTHUS JAPONICUS*; D, *CLADIUM NUKU-HIVENSE*.

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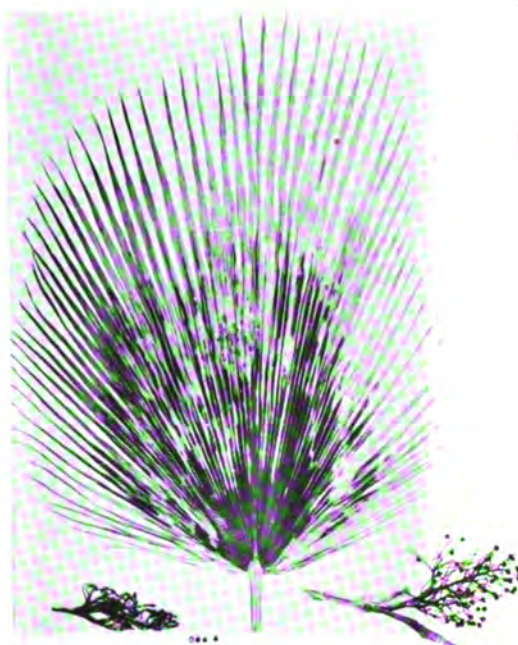


A



B

MARQUESAN VEGETATION: *A*, COASTAL CLIFFS COVERED WITH PENNISETUM AND ERAGROSTIS; *B*, TUSSOCKS OF PENNISETUM SIMEONIS AND ERAGROSTIS XEROPHILA.



A



B



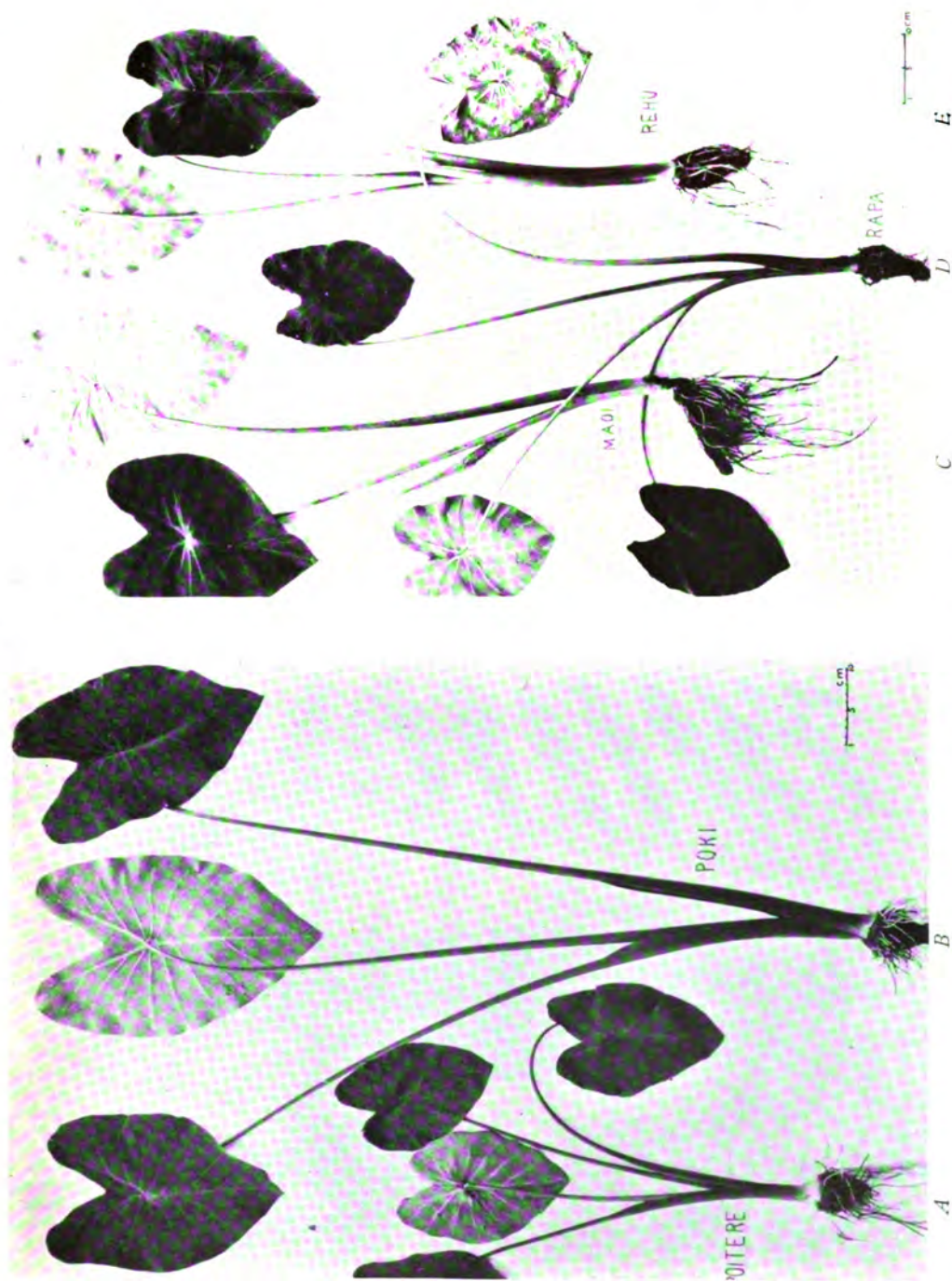
C

PALMAE: A, PRITCHARDIA PACIFICA VAR. MARQUISENSIS; B AND C, COCONUT TREES.

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PELAGODOXA HENRYANA: A, LEAF AND FRUIT; B, TREE; C, FRUITS.



VARIETIES OF TARO.

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A



B



C

MONOCOTYLEDONS: A, CURCUMA LONGA; B, HEDYCHUM FLAVUM; C, XANTHIOSOMA ATROVIRENS.



A



B



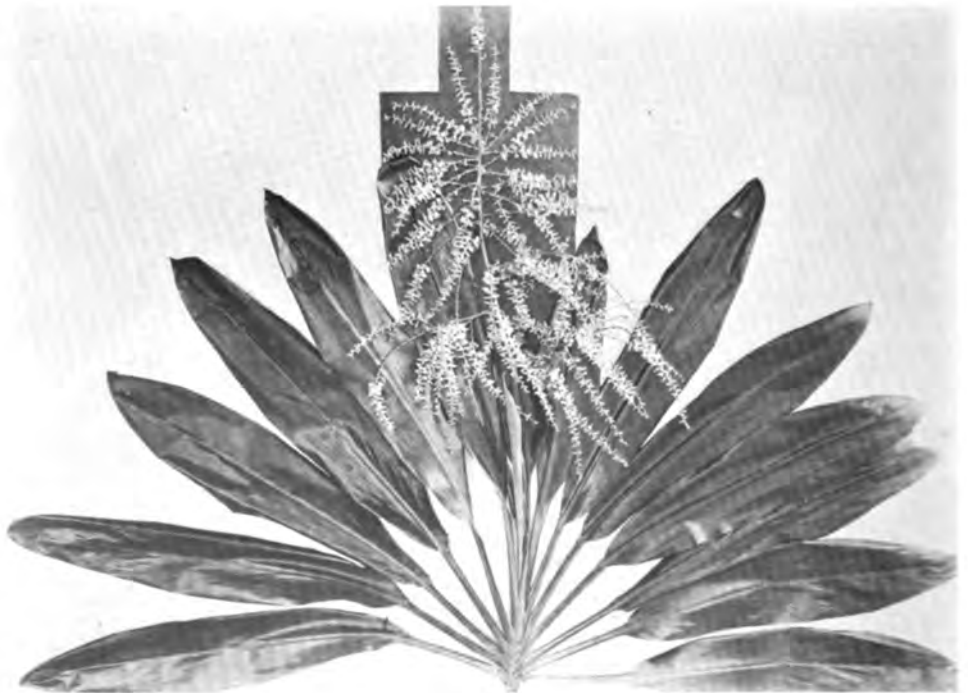
C

MONOCOTYLEDONS: A, *DIOSCOREA BULBIFERA*; B, NATIVE PINEAPPLE; C, *MUSA PARADISIACA*.

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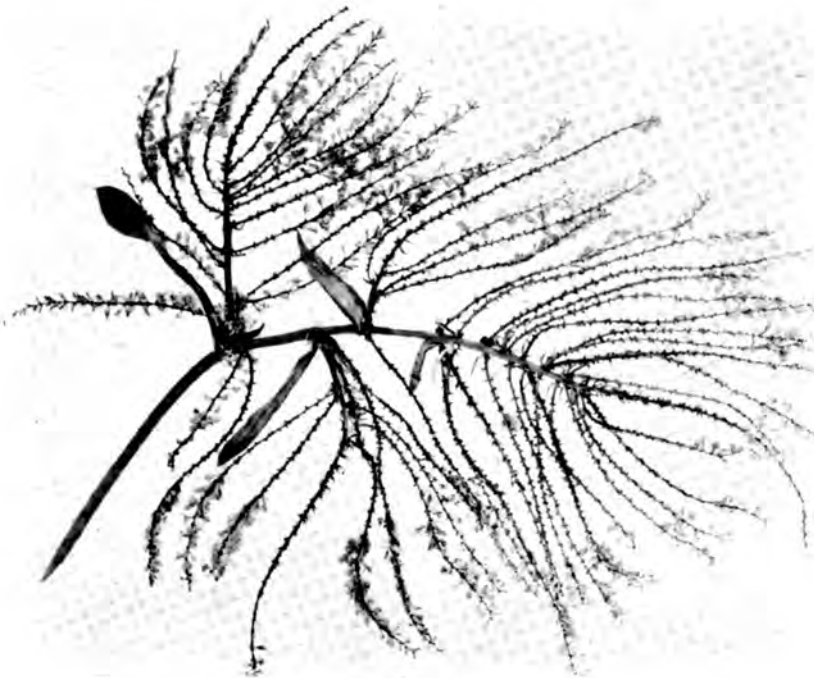
A



B

VARIETIES OF *CORDYLINE TERMINALIS*.

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A



B

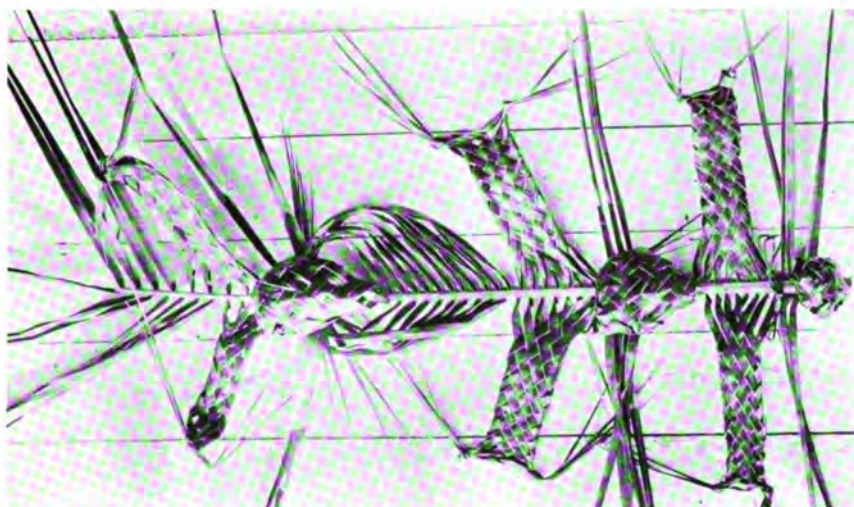
VARIETIES OF *CORDYLINE TERMINALIS*.

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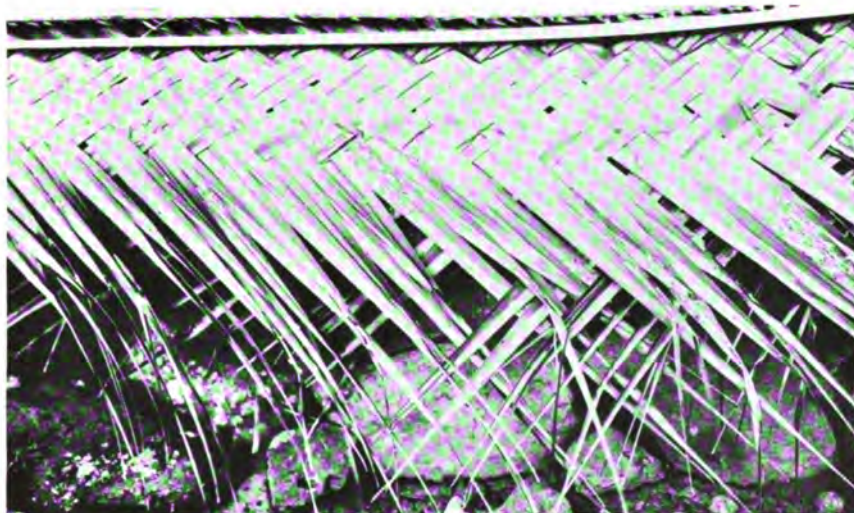


ORCHIDACEAE: LIPARIS CLYPEOLUM VAR. MARQUISENSIS.

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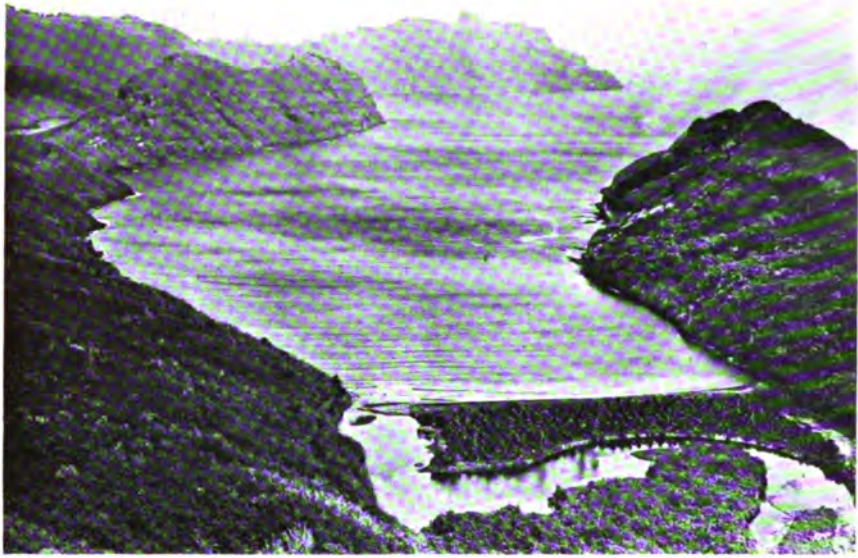
A



B

USES OF COCONUT LEAVES.

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A



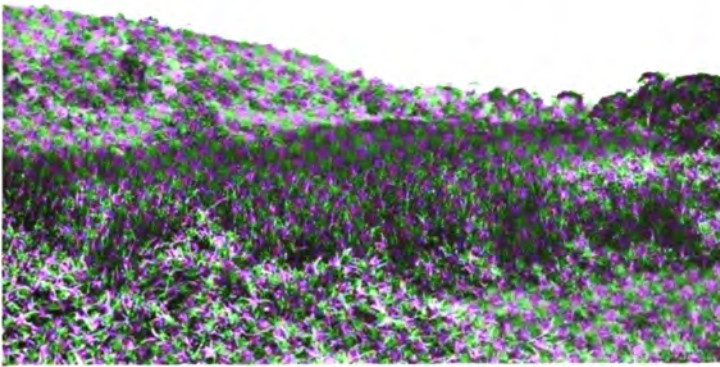
B

MARQUESAN TOPOGRAPHIC FEATURES: *A*, MOUTH OF TAIPU VALLEY; *B*, VIEW OF TOVII REGION.

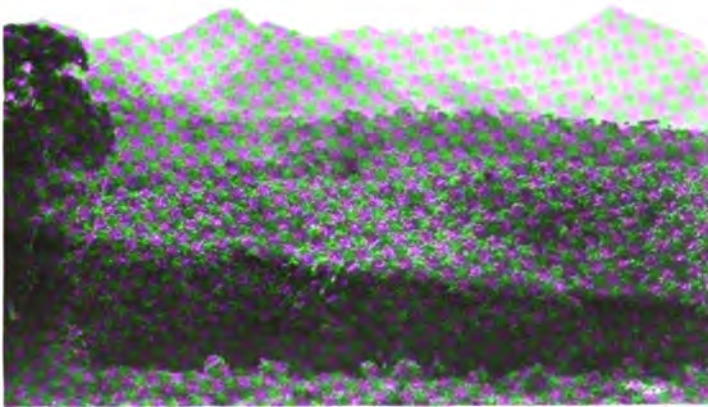
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A



B



C

MARQUESAN TOPOGRAPHIC FEATURES: *A*, LICHEN COVERED RIDGE CREST; *B*, BOG; *C*, FOREST COVERED CRATER LAKE.

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