

## Notes on *Pandanus* in the Line Islands

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The Line Islands, or as they are also called, the Pacific Equatorial Islands, consist of a few small remote atolls with Kingman Reef, Palmyra, Washington, Fanning, and Christmas Islands fairly close together near the 160<sup>th</sup> meridian (160° W. Long.) and from about 8° North of the Equator to 2° North; slightly south and west is Jarvis, near the intersection of the 160<sup>th</sup> meridian and the Equator; while south and east lie a few isolated atolls, Malden, Starbuck, Caroline, Vostok, and Flint, the last about 12° South of the Equator near the 150<sup>th</sup> meridian. The vegetation of these islands is for the most part quite sparse; reports have been published by Christophersen (1927) and various other workers (see Christophersen for a bibliography). *Pandanus* occurs on several of these islands, and is abundant on some of them; on others, it appears to be absent. The present paper is concerned with three of these islands: Palmyra, Washington, and Christmas.

The vegetation of Palmyra has been subjected to two rather intensive studies, that of Rock and collaborators (1916) and that of Dawson (1959). Martelli, in Rock's paper, described two taxa of *Pandanus* from Palmyra. One of these, *P. pulposus* var. *cooperi*, is now represented by cultivated specimens growing in Honolulu. The other, *P. rockii*, is known from a few collections only. An intensive study of the *Pandanus* of the Marshall Islands recently completed (Stone, unpubl.) indicates that this species, is better regarded as a form of *P. fischerianus*. Another species described from Washington Island, *P. bergmanii*, is also regarded as a form of *P. fischerianus*.

*Pandanus rockii* is a remarkable plant, and its fruits are quite distinct from most other species in respect to general shape. Of its leaves nothing is known. From the photographs of the tree in Rock's paper (1916: pls. 5-7) the leaves are probably about 250 cm long and perhaps 9-10 cm wide, (not unusually large), and they taper gradually to the long flagelliform tip so characteristic of the species of Section *Pandanus*, to which it belongs. The trees apparently grow to a height of forty feet or more; in pl. 7 the proproots appear both basally on the trunks and extending down for many feet from the branches.

A few collections have been made since Rock's time. In comparing these with the numerous collections available from Micronesia, it became apparent that it would not be possible indefinitely to consider *P. rockii* as a valid species. Nonetheless, it appears to be a good variety endemic to Palmyra; one of the only plants endemic to these remote atolls.

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\* This brief study formed a necessary adjunct to my dissertational project on Marshall Islands *Pandanus*, now in press (Pacific Science). To Prof. H. St. John I express my appreciation for his aid and supervision.

*Pandanus fischerianus* Martelli var. **rockii** (Martelli) B. C. Stone comb. nov. (Figs. 1-2).

Basionym: *Pandanus rockii* Martelli, in Rock, 1916, Palmyra Atoll.—Dawson in Pacif. Naturalist (Contrib. Beaudette Found. Biol. Res.) 1(2): 24. Figs. 8, 12, 16. 1959. [Observed, not collected].

Holotype: PALMYRA ATOLL. Holei Islet, July 1913, *J. F. Rock* (Bish).

Specimens examined: PALMYRA ATOLL, 13 June, 1935, *A. F. Judd and D. Mitchell* (Bish).

Martelli gives as the carpel number per phalange "11-12"; the Judd & Mitchell collections show that the variation, as might be expected, is considerably greater, one phalange has 8 carpels, one has 12, and one has 13 carpels. The carpels are somewhat more acute than those of the type; and, as are the lateral faces, are more abundantly striated by longitudinal corky scars. The taxon seems very similar to the Marshallese edible clone "lōjōkdār", the chief differences being the more acute exerted inner carpels of var. *rockii*. If there is in fact a relationship, it would seem that var. *rockii* must have arrived from the Marshall Islands; at least, this route is more plausible than the reverse. Whether the clone now widely propagated and called "lōjōkdār" existed before the Marshallese began to utilize it is unknown. The edible qualities of var. *rockii* are also unknown.

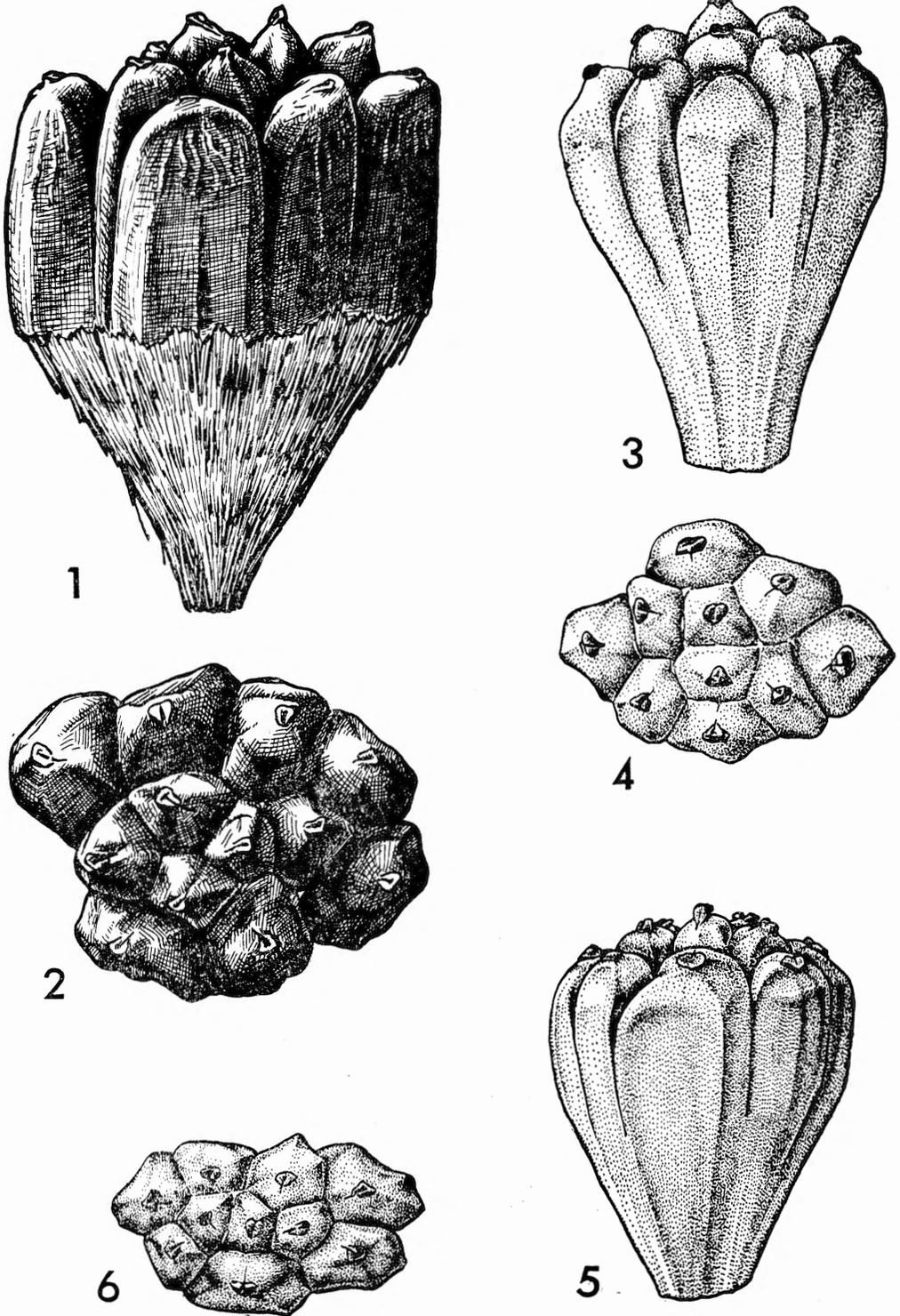
Comparison of hundreds of specimens from Micronesia with the few available from the Line Islands leads to the conclusion that var. *rockii* is the result of a combination of tendencies, which, singly or in various groupings, are observable in other species, but in var. *rockii* developed to an extreme. There is a general enlargement in phalange size, coupled with increased exertion of the inner carpels, enlargement of the stigmas, multiplication of the carpels resulting in a high average number, and deepening of the lateral sutures. Some of these characters are manifest in a species known only from Palau, *P. divergens* Kanehira; but this differs in its truncate phalange apices and small stigmas. Both, however, have phalanges of similar size, with numerous corky scars on the sides, and free convex carpel apices.

*Pandanus fischerianus* Martelli var. **cooperi** (Martelli ex Rock) B. C. Stone, comb. nov. (Figs. 3-7).

Basionym: *Pandanus pulposus* var. *cooperi* Martelli ex Rock, l.c.

This differs from var. *rockii* in having shorter, smaller phalanges with less carpel separation, both apical and lateral, and more rotund, pyriform apices. It closely resembles a specimen from Kwajalein (*Stone* 904) which is described elsewhere as a form of this variety, differing in the somewhat more exerted inner carpels and the longer free carpel apices, as well as being much less compressed.

With var. *rockii* as an arbitrary end point, and var. *pulposus* as an arbitrary starting point, a series of more or less intergrading forms can be discerned, indicative perhaps of relationship although not necessarily of descent: *P. fischerianus* var. *pulposus*, var. *bryanii*, var. *cooperi*, var. *rockii*. Such a series probably could be read in either direction. Other specimens are available which might be cited to show different progressive series, based on various features. A combination of these might reveal an interconnected, or reticulate, pattern, which would probably



Figs. 1. *Pandanus fischerianus* var. *Rockii*. Phalange in profile  $\times 1$ . 2. The same, in top view  $\times 1$ . (From Judd & Mitchell). 3. *Pandanus fischerianus* var. *cooperi*. Phalange in profile  $\times 1$ . 4. The same in top view  $\times 1$ . 5. The same, another phalange in profile  $\times 1$ . 6. The same, top view  $\times 1$ . All from a tree cult. on Univ. Hawaii campus planted from seed brought from Palmyra Atoll by J. F. Rock in 1916.

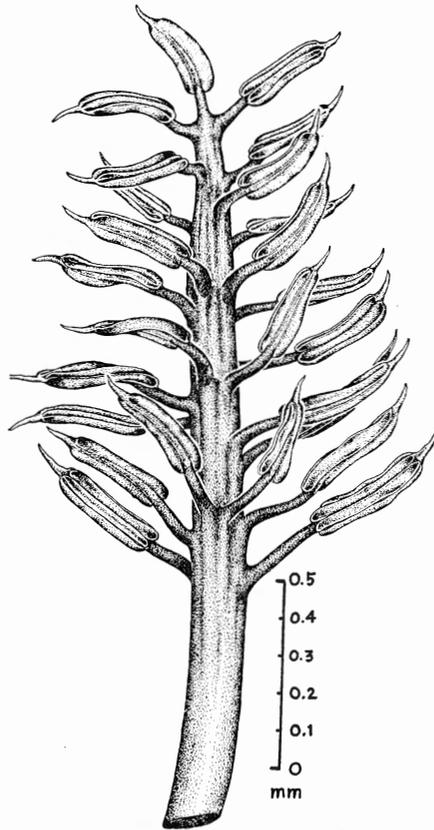
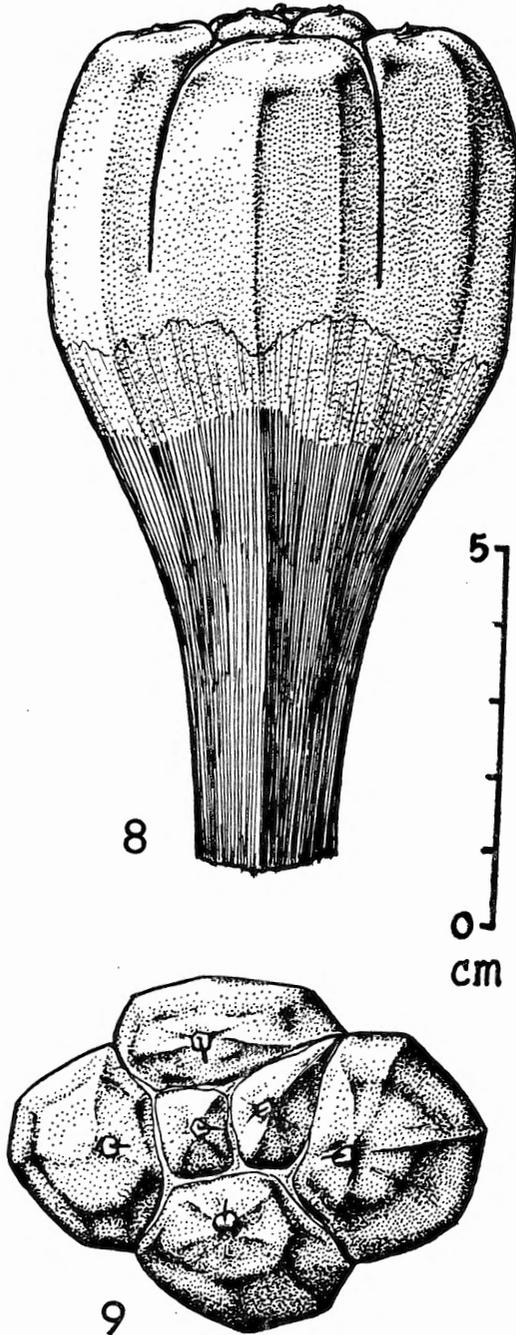


Fig. 7. Phalange of stamens of *Pandanus fischerianus* var. *cooperi*, cult. on Univ. Hawaii campus (*St. John* 25592, Bish), planted from seed brought from Palmyra Atoll by J. F. Rock in 1916.

reflect more accurately the complex relationships of the various taxa.

The Line Islands have been largely uninhabited; certainly, there has been no history of continuous occupation. The *Pandanus* of these atolls is thus essentially of a wild type, but drift from areas of cultivars is probable, and a study of them is of great importance when one considers the numerous cultivated forms found in the adjacent, though remote, atolls of the Gilbert and Marshall Islands. Unfortunately, field observation is really required for valid comparisons. On the basis of comparisons of dried specimens, it appears that there is very little resemblance between the *Pandanus* of the Line Islands and those of the Marshall Islands; but there is at least one instance of similarity between plants of the Gilbert Islands and Line Islands. This example is a large-fruited pandanus which F. B. H. Brown described first in 1930 as *P. bergmanii*. It is here regarded as:

*Pandanus fischerianus* Martelli var. *pulposus* (Warburg) Stone f. *bergmanii* (F. Br.) B. C. Stone, comb. nov. (Figs. 8-9).



Figs. 8. *Pandanus fischerianus* var. *pulposus* f. *bergmanii*. Phalange in profile  $\times 1$ . 9. The same in top view  $\times 1$ . From *H. F. Bergman* 104, type.

Basionym: *P. bergmanii* F. Br., Occ. Pap. Bish. Mus. 9(4): 4-5. 1930.

Holotype: WASHINGTON ISLAND, *H. F. Bergman* 104 (Bish).

Description: Shrubs about 5 m high; leaves 110×5 cm marginally serrate-dentate, the dorsal costa basally smooth; syncarp broad-ellipsoid, 34×29 cm, of 87 phalanges; phalanges long-pyriform, the upper 1/3 free, 12×6.5 cm, the apex subtruncate, spical sutures shallow, lateral sutures prominent, carpels 6-9; stigmas 2-3 mm diameter; endocarp 3.5 cm high; seeds about 12 mm long.

No further specimens of this form have been collected, but the type is an ample collection, probably of an entire syncarp or perhaps two syncarps; the phalanges are dissociated but are remarkably uniform.

Brown (1930) claimed a relationship between this taxon and *P. leram* of the Nicobar and Andaman Islands in the Indian Ocean. The resemblance is limited, however, to the dimensions of the phalanges; otherwise they are similar only in that they are generically related. *P. leram* is in fact in a different section of the genus (*Hombroonia*).

*P. fischerianus* var. *pulposus* f. *bergmanii* differs from f. *pulposus* in the considerably longer lower mesocarp, the more truncate apex of the phalange, and the horizontal rather than sloped outer carpal apices. The sides are smooth. The outer carpels are large, at the apex up to 2.8×2 cm, while the inner carpels are smaller, usually about 1×1 cm at the apex. Brown states that the inner carpels are "reduced". His implication is that the trend of evolution has been the reduction of carpal number, with the inner series being gradually reduced in size and number of carpels and perhaps ultimately disappearing. Since, however, it is almost always the inner carpels with a fertile, and the outer carpels which are often sterile, specialized and providing buoyancy, this trend seems quite unlikely. Wild species are known with a wide range of normal carpal numbers, 2, 3, 5, 7, 8, and more (Stone, 1967). At present it seems entirely possible that evolutionary processes have in some cases resulted in a decrease in carpal number, and in other cases in an increase. The specialization of the phalanges has in certain species preceded toward a more efficiently buoyant and salt-water-resistant means of dispersal. The partially hollow mesocarp chambers, traversed by fibers which connect the horizontal partitions of pith or "aerenchyma", and the light endocarp, with a reduced portion of the dense, osseous, reddish-brown sclerocarp and an increased proportion of white ligneous lighter tissue, are two such specializations. The inner carpels are generally smaller, but their small size is not necessarily a sign of evolutionary reduction in carpal number. Where carpal number is small, the carpels are of about equal size, and there is in no indication that inner carpels have been superceded; *Pandanus kusaicolus* Kanehira, with typically 2-carpellate phalanges, is an example.

Washington Island is directly south of the Hawaiian Islands, and is about two thousand miles from the Marshall Islands; some atolls of the Gilbert Islands are slightly closer, but none closer than 1200 miles. Forma *bergmanii* is similar to certain Gilbert Island cultivars. Washington Island has never been permanently settled, although habitation of the island for a certain period has occurred, as is evidenced by ancient stone-walled enclosures. Forma *bergmanii* certainly appears to be one of the edible cultivars; the large phalanges, with their proportionally long mesocarp below the seeds, is typical of many edible cultivars. In recent

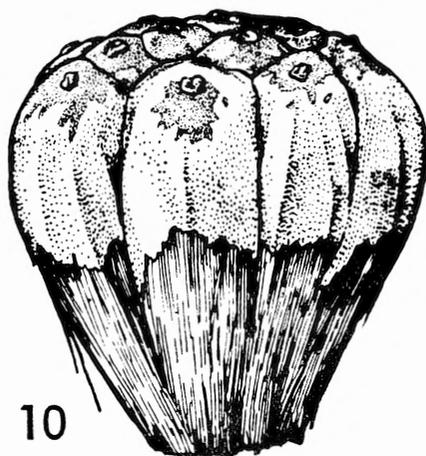
times, Gilbertese laborers have been brought to Washington Island, and it is possible that forma *bergmanii* is a Gilbertese cultivar, brought by these workers.

*Pandanus fischerianus* Martelli var. *bryanii* B. C. Stone, var. nov. (Figs. 10-11).

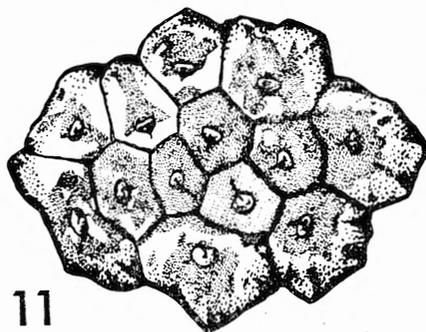
Phalanges turbinatae, 6 cm longae, 5.3-5.8 cm latae, 9-13-loculares, in apice convexae, basi in sicco valde angustatae, faciebus sulcatis. Apices carpelorum truncatae, exteriores omnes declivitates, superficiebus suberosis. Stigmata 3×2-3 mm. Ab *P. fischerianus* var. *pulposus* in carpelis 9-13 fere 11 (non 5-12 fere 7), stigmatibus latioribus et faciebus cum canaliculis tenuibus brevibus differt.

Holotype: PALMYRA ATOLL, *E. H. Bryan Jr.* 1403 (Bish).

This variety appears best associated with *Pandanus fischerianus*, the type of which is from the Marshall Islands. The type specimen of *P. fischerianus* is a cultivar; specimens inseparable from it were collected under the cultivar name "ajbwirik". The variety described above is a plant characterized by the smaller phalanges with more numerous carpels, the phalange apex broadly rotund-convex, the outer carpels sloping, adnate, the inner carpels smaller and adnate, thus the



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Figs. 10. *Pandanus fischerianus* var. *bryanii*. Phalange in profile×1. 11. The same, in top view×1. From *Bryan* 1403, type.

apical sutures very shallow. The sides bear accessory ribs and grooves as well as the intercarpellary sutures. The phalange apex is abundantly set with corky scars and patches, usually in areolas around the stigmas.

The variety appears to include two forms:

- (a) var. *bryanii* forma *bryanii*, of which the holotype is Bryan 1403;  
and (b) var. *bryanii* forma *compressus* B. C. Stone f. nov.

Phalanges valde sulcatae, 7-14-loculares, coartatae, non rotundae.

Holotype: MARSHALL ISLANDS, Kwajalein Atoll, *B. C. Stone* 904 (Bish).

This form differs from the typical form in the strongly flattened phalanges. The syncarps are ovoid, 30×25 cm; the phalanges 6-6.5×4-6.5 cm, with curving or subparallel sides; carpels 7-14, usually 7-9, adnate, the outer series slightly larger than the inner series, sloping, and apically truncate; stigmas large, 2-4 mm long, on the outer carpels mostly retrorse; mesocarp above cavernose, below fibrous; endocarp median, 25 mm long; seeds 16×5 mm.

Known so far only from Kwajalein Atoll in the Marshall Islands.

#### *Disposition of Pandanus Hermsianus Martelli*

This species was described by Martelli (1926) on the basis of a single phalange "picked up on the beach by Professor W. B. Herms" in Fanning Island, in August 1924, and deposited in the University of California Herbarium (No. 276345). Martelli suggested *Pandanus spiralis* R. Br. as a possible relative. He also mentioned that he felt it probable that the pandan was not a native of Fanning Island, but had drifted from elsewhere.

Without belaboring the fact that this single, damaged phalange should never have been taken as the type of a new species, it may be mentioned that in its very broad multilocular endocarp and relatively short basal mesocarp fibers, the phalange is reminiscent of certain large, polycarpellate, broader-than-long phalanges produced by Australian pandans. On the other hand, it is quite possible that the basal mesocarp fibers have simply been abraded to their present shortness by sand and seawater, or perhaps have been nibbled at by animals (I have seen hermit crabs, for example, doing this in the Marshall Islands). Also there is the possibility that the basal mesocarp fibers have been cut off by someone who then used the mesocarp pulb. In other words, it seems to me that this could well be a drift phalange from the Marshall or Gilbert Islands, I suggest it is probably one of the large cultivars of *Pandanus fischerianus* Martelli, such as CV. "edwaan-en-an-Nelu" of the Marshall Islands. I very much doubt that it represents a distinct species. In any case it is an example of unnecessary and unwise description and nomenclature.

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