

THE PACIFIC SPECIES OF *OPHIORRHIZA* L. (RUBIACEAE)¹

STEVEN P. DARWIN²

Ophiorrhiza is an Indo-Malesian genus belonging to the family Rubiaceae and comprising about 150 species (Airy Shaw, 1973). The genus is taxonomically complex in many parts of its range, but a worldwide treatment has never been attempted. This study is limited to a taxonomic consideration of the Pacific species of *Ophiorrhiza*. The Pacific, as here understood, is the area extending from the Caroline and Marianas Islands, the Santa Cruz Islands, and the New Hebrides eastward to the Hawaiian Islands and Easter Island. It is equivalent to Takhtajan's (1969) Polynesian Subkingdom except that the Bonin Islands are excluded. This exclusion is based on evidence presented by van Balgooy (1971) that the Bonins are floristically more Asian than Oceanic. Fifteen species of *Ophiorrhiza* are treated here, four of them being described as new.

I wish to thank the administrators of the following institutions who have made their herbarium collections available: Arnold Arboretum of Harvard University (A); Bernice P. Bishop Museum (BISH); British Museum (Natural History) (BM); Field Museum of Natural History (F); Gray Herbarium of Harvard University (GH); Royal Botanic Gardens, Kew (K); Department of Botany, University of Massachusetts (MASS); Missouri Botanical Garden (MO); New York Botanical Garden (NY); Muséum National d'Histoire Naturelle, Paris (P); Departments of Agriculture and Forestry, Suva, Fiji (SUVA); University of California, Berkeley (UC); and U.S. National Herbarium (US).

***Ophiorrhiza* L. Sp. Pl. 150. 1753, Gen. Pl. ed. 5. 74, as *Ophiorrhiza*. 1754; Seem. Fl. Vit. 126. 1866; Drake, Fl. Polynés. Franç. 86. 1893.**

Prior to 1753, Linnaeus had published the genus *Ophiorrhiza* based

¹I wish to thank Dr. Albert C. Smith for his many helpful suggestions pertaining to this study. I also wish to acknowledge the aid of Dr. David W. Bierhorst in interpreting raphid crystals, and that of Dr. James W. Walker in discussing pollen characters. This paper is based on research partially supported by a grant from the National Science Foundation, with Dr. Smith as principal investigator.

²Department of Botany, University of Massachusetts, Amherst, Mass. 01002.
Present address: Gray Herbarium, 22 Divinity Ave., Cambridge, Mass. 02138.

Fiji and the Horne Islands. It is known that Graeffe collected on the island of Viti Levu, and in several other instances it is reasonably certain that his specimens labeled "Samoa" actually came from Fiji (A. C. Smith, personal communication). I have therefore considered this Graeffe collection as being of Fijian origin.

The absence of *Ophiorrhiza* from Samoa, Tonga, the Cook Islands, and the Austral Islands is unexpected, in view of its relative abundance and diversity in Fiji and the Society Islands. It is not known whether intermediate archipelagoes once supported populations of *Ophiorrhiza* which have since become extinct, or whether the presence of *Ophiorrhiza* in the Society Islands is the result of chance long-distance dispersal which never involved intermediate land areas. The latter is probably the more likely hypothesis, since there is no obvious reason why *Ophiorrhiza* should not have persisted in such forested archipelagoes as Samoa once it had become successfully established.

MORPHOLOGY

The basic characters discussed below being more or less generic in nature, they are not repeated in the specific descriptions unless particularly significant.

Habit and habitat. The species of *Ophiorrhiza* in the Pacific vary from procumbent herbs to shrubs about three meters high. Considerable variation is encountered within many species, but most are suffrutescent herbs of about fifty centimeters. Some authors (Drake, 1893) have placed considerable weight on habit as a key character separating Tahitian species, but so much variation in habit is encountered as to preclude the use of such characteristics as defining species. Most species have been described as perennial, but some, specifically *O. palauensis*, have been referred to as annuals. Although the period of duration may prove to be of some taxonomic value, not enough reliable information is available to warrant its use as a key character in this study.

Habitat seems more reliable in characterizing some species of *Ophiorrhiza*. Most are inhabitants of humid, upland forests, but some (e.g. *O. leptantha*, *O. laxa*, *O. peploides*, and *O. palauensis*) have a wider altitudinal range. A few species (e.g. *O. orofenensis* and *O. tahitensis*) are known only from comparatively high elevations, while *O. rupestris* is restricted to a strand habitat.

Indument. The Pacific species of *Ophiorrhiza* are all pubescent to some degree, although in some species (e.g. *O. longituba*) the pubescence may be restricted to the inflorescences and the interior of the corolla tubes. Indument varies from small orange-yellow hairs (especially characteristic of *O. leptantha*, *O. nelsonii*, and *O. setosa*) to

cell. A second type of trichome is found in those species which are very minutely puberulent (e.g. *O. subumbellata*). Here the hairs are extremely small and consist of but one curved cell (FIGURE 1, H). In the third trichome type the hairs are elongate and unicellular (FIGURE 1, A&B). Such hairs have been found only on the interior of corolla tubes and at corolla throats; Verdcourt (1958) is of the opinion that multicellular hairs on the interior of corolla tubes in the Rubiaceae are very rare. The walls of these unicellular hairs were found to be subparallel in all species examined except those of *O. rupestris*, in which the walls are distinctly undulate in optical section (FIGURE 1, A). In all the trichomes observed, the walls of the cells are tuberculate to striate. No crystals were found in the cells of the trichomes.

Leaves and stipules. The leaves of Pacific species are, with but one exception, petiolate, chartaceous to membranaceous, and entire. In outline they usually vary from obovate to ovate; they are acute to acuminate at apex, and decurrent on the petiole at base. In *Ophiorrhiza rupestris*, the leaves are often obtuse to rounded at apex and are frequently subfalcate (FIGURE 3, E). In *O. peploides*, the leaves are considerably smaller than in other species and are often spatulate in outline and apparently sessile on the branchlets; the margins may be somewhat crenulate (FIGURE 4, D&E). In all species the upper surfaces of the leaf blades dry dark, while the blades remain paler beneath. In some, e.g. *O. nelsonii*, the lower surfaces of the leaf blades dry with a distinct orange color; in others the leaves have a yellowish cast (*O. leptantha*). *Ophiorrhiza solandri* is the only Pacific species characterized by having rugose leaves, the secondary nerves being distinctly elevated above when dry (FIGURE 10, B). In *O. orofensis*, the secondary nerves become pale when dry, while the lamina remains dark (FIGURE 10, G).

Among the species studied, stipule form has been found to be a valuable taxonomic character. In general, the stipules are interpetiolar, but they vary greatly in shape, size, and persistence. Stipules are easily observed in all species except *Ophiorrhiza peploides*, in which they are extremely small and ephemeral; Seemann (1866) was of the opinion that this species was exstipulate. Among the other Pacific species, at least three stipule types are recognizable: (1) stipules which are setaceous to narrowly subulate over most of their length and have only a small membranaceous base, as in *O. brachyantha* (FIGURE 4, A), *O. laxa* (FIGURE 4, H), *O. leptantha* (FIGURE 6, D), *O. palauensis* (FIGURE 6, F & G), and *O. setosa* (FIGURE 7, B); (2) those which are almost entirely made up of a larger membranaceous body and are variable at apex but often fimbriate, as in *O. nelsonii* (FIGURE 7, D) and *O. tahitensis* (FIGURE 8, D); and (3) those which are more minute, coria-

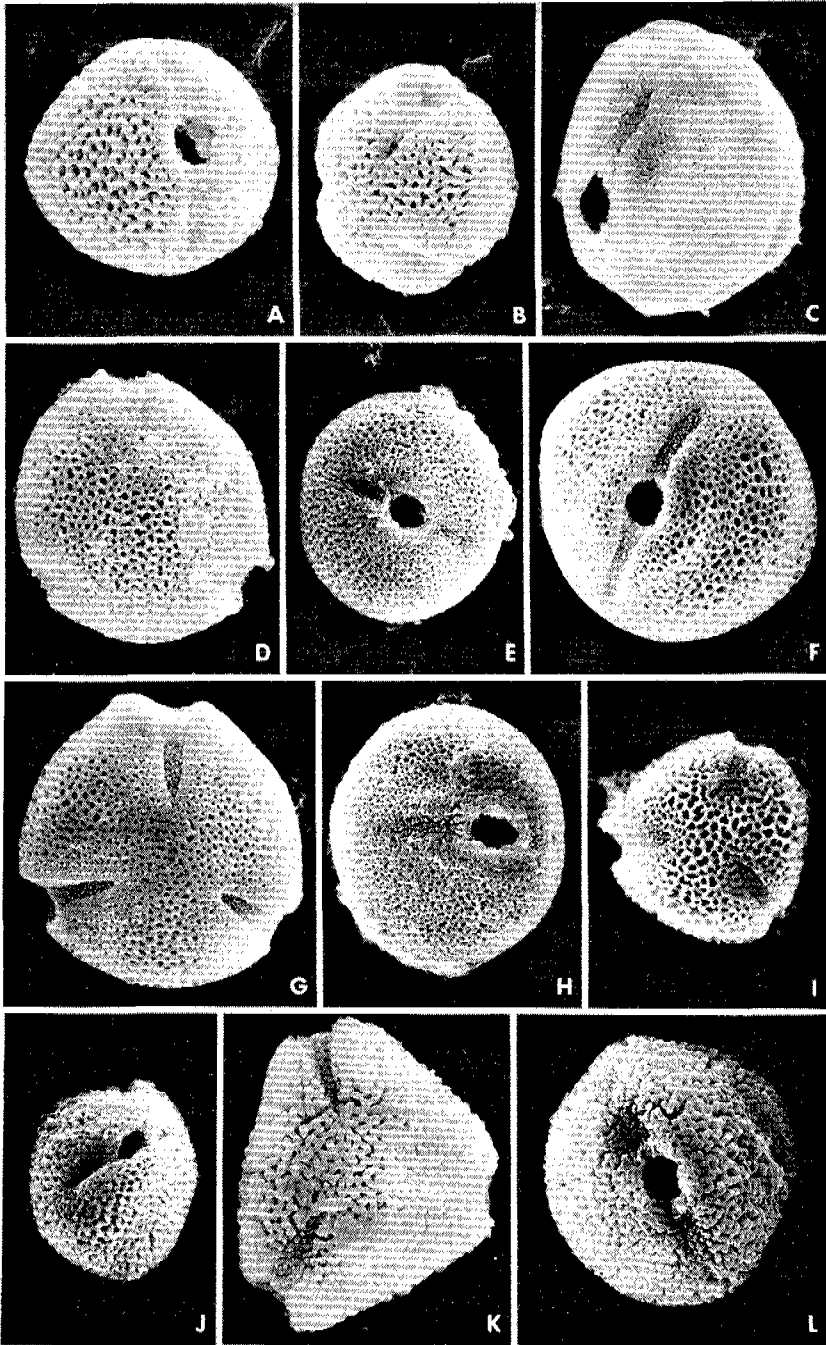
defining characters, since they appear to be reasonably stable.

Inflorescence bracts are frequently encountered in species of *Ophiorrhiza*, and their presence or absence was considered by Schumann (1891) to be of considerable importance in defining species groups within the genus. I have found bracts to be variously present in the inflorescences of all Pacific species. In some specimens of *O. peploides*, *O. leptantha*, and *O. laxa*, bracts may be strongly developed, while they are lacking entirely in other specimens of the same species. Similarly, bracts are known only in the flowering inflorescences of *O. longituba*, and are only occasionally discernible in *O. rupestris*. As the inflorescence bracts are variable in occurrence, so are they variable in shape from broadly subulate to setaceous. However, their overall form and maximum length seem to be species-specific within limits.

Perianth. The calyces of *Ophiorrhiza* species are relatively small and consist of five lobes which are quite free or somewhat fused toward the base. In the Pacific species examined, the calyx lobes are essentially deltoid, but in *O. palauensis* they may be somewhat lanceolate and proportionately long.

The corollas of the species of *Ophiorrhiza* which I have examined are most often white, but sometimes they are pink, purple, yellow, or red. To some extent the corolla color is species-specific, but some species (e.g. *O. leptantha* and *O. laxa*) are quite variable in this respect. Among the Pacific taxa the corolla shape also differs. In most cases the corollas are narrowly infundibular to somewhat hypocrateriform (FIGURES 4, F; 6, A; 7, C; 8, A); they are usually considerably longer than broad. Very short corollas are found in *O. rupestris* (FIGURE 3, D) and *O. brachyantha* (FIGURE 3, G), and in the former species they may be somewhat urceolate. The corollas of *O. peploides* are broadly infundibular and, unlike those of any other species examined, have lobes nearly equal to or exceeding the tube in length (FIGURE 4, C).

The exteriors of the corollas in some species (e.g. *Ophiorrhiza tahitensis* and *O. nelsonii*) may vary from puberulent to glabrous (FIGURE 7, E & F). The corolla tubes of *O. longituba* and *O. solandri* are always glabrous without, those of *O. peploides* only rarely puberulent. The indument on the interior of the corolla tubes is also variable, but it seems more usable as a specific character. In some species (e.g. *O. peploides* and *O. brachyantha*), the corolla tube is glabrous within, while in others the interior of the tube is puberulent throughout (e.g. *O. palauensis*). In many species (all from the Society Islands) the indument is restricted to an area of the tube below the point of attachment of the stamens. The corolla tubes of *O. leptantha*, *O. laxa*, and



REPRODUCTIVE BIOLOGY

Schumann (1891) listed *Ophiorrhiza* as one of a number of rubiaceous genera in which heterostyly is well developed. Later authors, however, have not considered *Ophiorrhiza* as having true heterostyly, and the genus was not listed by Vuilleumier (1967) in her review. Verdcourt (1958) specifically stated that species of his tribe Ophiorrhizeae (comprising *Ophiorrhiza* and *Spiradiclis*) are not heterostylous. In a casual examination of specimens from localities throughout the range of the genus, I have not found evidence of heterostyly; it is certainly not present in any of the Pacific species. The variable location of the stamens in the corolla tubes of *O. leptantha* (FIGURE 5, B-H) may have some significance in the regulation of pollen flow, but no evidence of this has been accumulated. In the proper sense, this species is not heterostylous, since the positions of the stigma and anthers are not reciprocal from flower to flower. A similar situation has been reported by Verdcourt (1958) for *Sipanea* Aubl., a genus usually placed in or near the tribe Rondeletieae.

The shape of the elongate corolla tubes in most of the Pacific species of *Ophiorrhiza* suggests that the flowers are pollinated by lepidopterans, an hypothesis also supported by the well-developed floral disk which is present at the base of the corolla. Species with shorter or more open tubes (e.g. *O. rupestris* and *O. peploides*) may be pollinated by other insects. In the Fijian species the anthers are frequently exerted beyond the corollas; in those cases the flowers may be wind pollinated. I have found no evidence to suggest that the flowers of the Pacific species are functionally unisexual.

PHYLOGENY

Tribal relationships. In having opposite, stipulate leaves, sympetalous corollas, and inferior ovaries, *Ophiorrhiza* is a typical member of the Rubiaceae. In the past, *Ophiorrhiza* was associated with other genera having numerous seeds in each ovary locule, and it has consequently been placed by concerned authors in the subfamily Cincho-noideae or its equivalent (Hooker, 1873; Schumann, 1891). Because the seeds of *Ophiorrhiza* are unwinged and the aestivation of the corolla lobes valvate, the genus has, by the same authors, been assigned to the tribe Hedyotideae. Systems for the classification of the Rubiaceae recently proposed by Verdcourt (1958) and Bremekamp (1966) have largely ignored the number of ovules per locule as a character defining subfamilies. Instead, both authors have employed other features, especially the presence or absence of raphid crystals, as indicating intergeneric relationships.

Bremekamp (1952) removed *Ophiorrhiza* from the Hedyotideae because, unlike other genera of that tribe, it was found not to possess

not have flattened fruits; in those same two features the Hedyotideae also differ from *Ophiorrhiza*, but in that tribe the ovules are usually many in each ovary locule.

Familiar only with the Pacific taxa, I am inclined to place *Ophiorrhiza* in the tribe Hedyotideae, although it would be a very distinct member of that taxon. Many characters of the genus, e.g. its usually herbaceous to suffrutescent habit, septate hairs, tricolporate pollen, and narrow corolla tubes, are not out of place in the Hedyotideae. *Ophiorrhiza* may indeed be closely related to *Spiradiclis*, although the latter genus possesses flowers which are sometimes four-parted, fruits which open by four valves, and thyrsoïd inflorescences.

Infrageneric classification. Schumann (1891) seems to have been the only author to have proposed an infrageneric classification of *Ophiorrhiza*. He divided the genus into two groups ("Reihe"), the first (*Ebracteolatae*) comprising species without inflorescence bracts, or with such bracts small and caducous; Schumann cited *O. mungos* and its close relatives as members of the group. The second "Reihe" (*Bracteolatae*) includes species in which the inflorescence bracts are well developed and the vegetative parts dry with a purple color; the group is characterized by *O. grandiflora* and *O. succiruba*. Although hypotheses about the infrageneric relationships of *Ophiorrhiza* cannot be safely constructed when only the Pacific species have been examined, I am inclined to consider Schumann's two infrageneric taxa unlikely to be natural. Such taxa based on a single character are notoriously unsound; within what appear to be otherwise homogeneous species I have found specimens with well developed inflorescence bracts and others in which the bracts are absent.

The Pacific species of *Ophiorrhiza*, because they represent geographical fringe elements of the genus, cannot be expected to show strong relationships among themselves. In other genera this has been found to be the case, the Pacific species probably being most closely related to eastern Asian or Malesian taxa. However, as a result of apparent secondary speciation in the Society Islands, a few species of *Ophiorrhiza* endemic to that archipelago seem to be closely interrelated; these species are *O. platycarpa*, *O. subumbellata*, *O. orofenensis*, and *O. scorpioidea*. The last three species are distinct in having subglobose fruits, a feature which I have not found reported elsewhere in the genus and one which, in conjunction with other characters, may warrant the recognition of those species as a separate infrageneric taxon of some rank. Clarification of the relationships of the species of *Ophiorrhiza* must await a worldwide revision of the genus; at least the New Guinean and southeastern Asian taxa must be reviewed before any firm conclusions can be reached.

Branchlets often more than 1 mm. in diameter toward apex; stipules commonly more than 2 mm. long and divided at apex.

Inflorescences usually with more than 15 flowers, more than 5 cm. long in fruit, densely puberulent with minute orange to yellow hairs, especially so on the peduncle; leaf blades often more than 10 cm. long and drying bright orange to orange-brown beneath; anthers 2.5–3 mm. long.....8. *O. nelsonii*.

Inflorescences with fewer than 15 flowers, less than 4.5 cm. long in fruit, glabrous to puberulent with curved, red-brown to stramineous hairs; leaf blades rarely more than 10 cm. long, drying pale green beneath; anthers 2–2.5 mm. long.

Leaf blades puberulent beneath with minute hairs often restricted to costa and secondary nerves; stipules rarely more than 10 mm. long; inflorescence bracts usually subulate, 0.3–1 (–1.5) mm. broad at middle, common in fruiting inflorescences; stigma 2–2.5 mm. long; fruits up to 3 mm. long at middle, rarely more than 7 mm. broad; branchlets usually puberulent with stramineous to reddish, curved hairs, rarely glabrous.

9. *O. tahitensis*.

Leaf blades glabrous beneath; stipules more than 10 mm. long; inflorescence bracts narrowly subulate to setaceous, about 0.3 mm. broad at middle, not common in fruiting inflorescences; stigma about 1 mm. long; fruits more than 3 mm. long at middle, more than 8 mm. broad; branchlets usually glabrous.

10. *O. longituba*.

Branchlets up to 1 mm. in diameter toward apex; stipules rarely more than 2 mm. long, not divided at apex..... 11. *O. platycarpa*.

Inflorescences slender and lax, up to 2 cm. broad, unbranched or occasionally branched once, rarely with more than 7 flowers; leaf blades conspicuously rugose when dry, the secondary nerves sharply raised above.

12. *O. solandri*.

Fruits subglobose, not especially laterally flattened, only slightly broader than long.

Inflorescences with fewer than 25 flowers, the peduncles less than 3.5 cm. long.

Branchlets usually less than 1 mm. in diameter toward apex; secondary nerves of leaf blade not especially yellowish above when dry; stipules less than 1 mm. long; inflorescences usually with fewer than 15 flowers, about 1.5 cm. broad at anthesis..... 13. *O. subumbellata*.

Branchlets more than 1.5 mm. in diameter toward apex; secondary nerves of leaf blade conspicuously yellowish above when dry; stipules commonly more than 1 mm. long; inflorescences usually with more than 15 flowers, more than 3 cm. broad at anthesis..... 14. *O. orofoensis*.

Inflorescences with more than 25 flowers, the peduncles commonly more than 3.5 cm. long..... 15. *O. scorpioidea*.

1. *Ophiorrhiza rupestris* Hemsl. in Kew Bull. 1894: 212. 1894; St. John & A. C. Sm. in Pacific Sci. 25: 340. 1971.

FIGURES 1, A; 3, B–E.

Ophiorrhiza cf. *harrisiana* sensu Guillaumin in J. Linn. Soc. Bot. 51: 555. 1938; non Heyne.

Subliguous herb to 35 cm. high, the indument composed of minute, curved, ferruginous to yellow hairs up to 0.1 mm. long, the branchlets slender, subterete, dark brown, 1–1.5 mm. in diameter toward apex; stipules caducous, subcoriaceous, deltoid, 0.5–1 mm. long, 1–1.5 mm.

throughout the Solomon Islands and is probably identical with *O. insularis* Val. in New Guinea (Merrill & Perry, 1945). It is a suffrutescens, littoral herb with white flowers. Flowering and fruiting material have been gathered between September and December.

New Hebrides. ESPIRITU SANTO: Big Bay, Tolomako, Malotchiritchiri Rocks, Raynal (*R. S. N. H.*) 16400 (BISH); Hog Harbour. *I. & Z. Baker 88* (BM); Tangoa, south of Santo, Morrison (K).

Horne Islands. FUTUNA: Singave, *McKee 19879* (BISH, P.).

The listed collections assigned to *Ophiorrhiza rupestris* agree well with material from the Solomon Islands. The species is readily recognized by the often subfalcate leaf blades and the long, spreading inflorescence branches which exhibit particularly well the helicoid cyme which is characteristic of the genus. Unlike those of most other Pacific *Ophiorrhizae*, the leaf blades of this species are often obtuse to rounded at apex and the inflorescence bracts are small and infrequent. In the size and shape of the stipules, as well as in the very fine indument, *O. rupestris* resembles certain Tahitian species, e. g. *O. subumbellata*, *O. solandri*, and *O. platycarpa*. However, from these *O. rupestris* differs in its much shorter and differently shaped corolla tubes, its elongate and often spreading inflorescence branches, and the shape of its leaf blades, among other characters. If the assignment by Merrill & Perry (1945: 13) of *O. insularis* to this species is correct, the range of *O. rupestris* extends northwestward into New Guinea, where its closest relatives are probably to be found.

From the one other New Hebridean species, *Ophiorrhiza brachyantha*, the present species is readily distinguished by the shape and size of the stipules, the length of the pedicels, the type of indument, and the infrequency of inflorescence bracts.

2. *Ophiorrhiza brachyantha* S. Darwin, sp. nov. FIGURES 3, F&G; 4, A.

Herba suffrutescens ad 70 cm. alta, indumento pilis curvatis multicellularibus ferrugineo-ochraceis ad 0.2 mm. longis plerumque ornata, ramulis gracilibus subteretibus apicem versus ad 1 mm. diametro fuscis; stipulis plus minusve persistentibus basi deltoideis membranaceis apice setaceis non divisis 4—7 mm. longis, basi circiter 1 mm. latis, utrinque pilis dispersis puberulis; petiolis gracilibus semiteretibus 7—25 mm. longis, ad medium plus minusve 0.5 mm. latis; foliorum laminis chartaceis, in sicco supra atroviridibus subtus pallidis, lanceolatis vel oblanceolatis, 6—11 cm. longis, 1.5—2.5 cm. latis, apice acuminatis, basi acutis vel in petiolum longidecurrentibus, integris, supra pilis dispersis puberulis subtus pilis ad costam et nervos secundarios et marginem restrictis, costa conspicua supra prominula vel canaliculata subtus elevata et rotundata, nervis secundariis utrinsecus 8—12 patentibus supra prominulis subtus elevatis et rotundatis, ner-

vis tertiariis et rete venularum utrinque aliquantum prominulis; inflorescentiis laxe 3- vel 4-ramosis 6-15-floris, sub anthesi circiter 2.5 cm. longis, 1-3.5 cm. latis, pedunculo puberulo 6-12 mm. longo, pedicellis puberulis ad 3 mm. longis, bracteis frequentibus plus minusve setaceis utrinque puberulis, 1.5-6 mm. longis, ad 0.1 mm. latis; calycis lobis coriaceis vel chartaceis deltoideis, 0.3-0.5 mm. longis, basi 0.3-0.5 mm. latis, apice acutis, integris glabris vel subtiliter puberulis; corollae tubo hypocrateriformi circiter 2.5 mm. longo, ad medium 0.5-1 mm. diametro, extus glabro intus subtiliter pilis aurantiacis minutis puberulo; corollae limbo circiter 3.5 mm. lato, lobis ellipticis circiter 1.5 mm. longis, 0.5-0.7 mm. latis, integris, apice acutis, extus glabris intus pilis aurantiacis minutis puberulis; staminibus circiter 1.5 mm. sub corollae fauce insertis, filamentis filiformibus ad 0.5 mm. longis, antheris dorsifixis oblongo-linearibus, circiter 1 mm. longis et 0.2 mm. latis, loculis e basi circiter 0.3 mm. liberis; ovario subgloboso circiter 1 × 1.5 mm., pilis aurantiacis minutis dense puberulo; stylo filiformi glabro, circiter 3.5 mm. longo et 0.1 mm. diametro; stigmatе clavato supra medium bifido quasi glabro, circiter 3.5 × 0.1 mm.; fructibus ignotis.

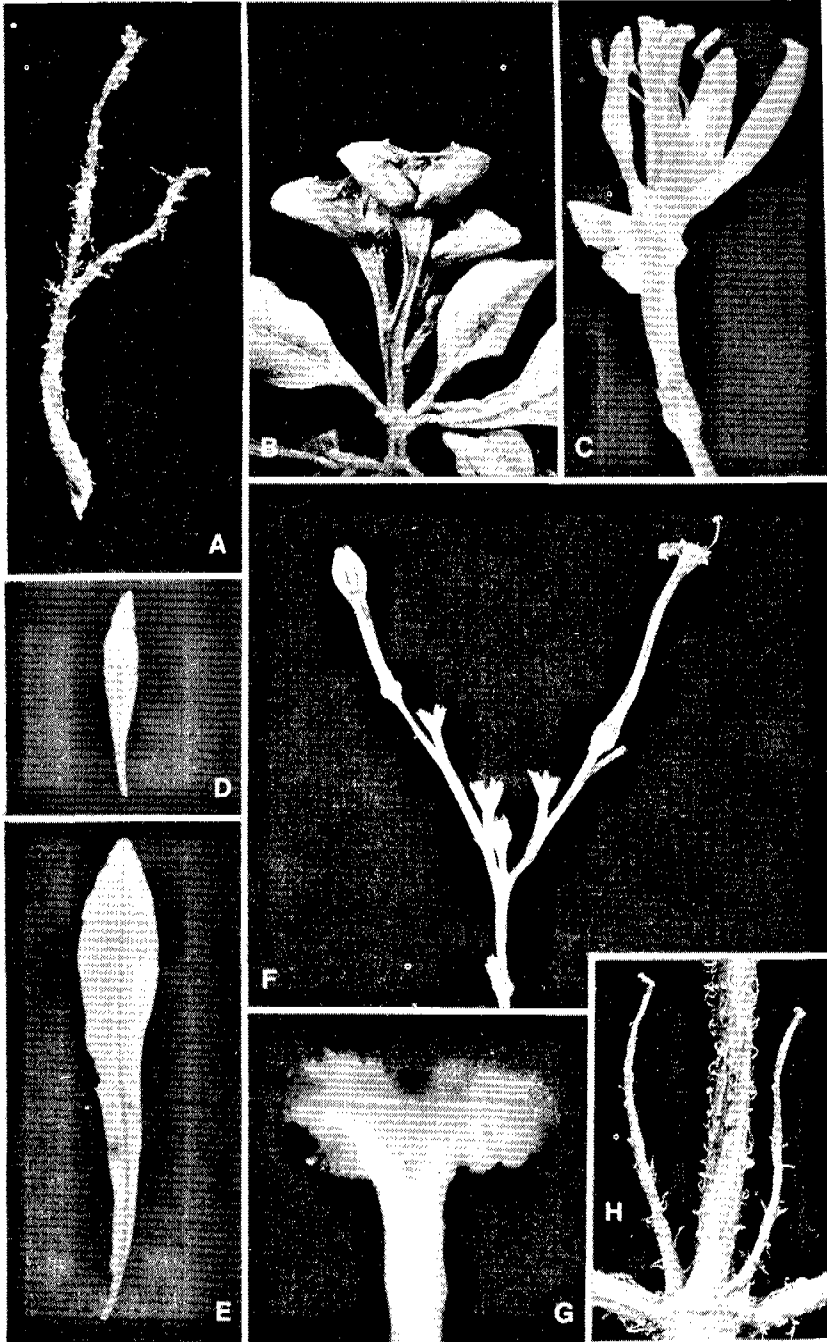
TYPE LOCALITY: As the type of this species I designate *Bernardi* 13298 from Eromanga, cited below. This collection, because of its more numerous flowers, is preferred to the Morrison number. Bernardi's label indicates that the first set of his material was deposited at Geneva, and an isotype may well be located there.

DISTRIBUTION: Restricted to the New Hebrides and thus far known only from the islands of Efaté and Eromanga. *Ophiorrhiza brachyantha* has been observed as an herb growing along watercourses at an altitude of 400-450 m. The corollas are white and the leaf blades are conspicuously pale beneath. Flowering material has been collected in June and August, but fruits are unknown.

New Hebrides. EFATE: Undine Bay, Mt. Macdonald, Morrison, Aug. 27, 1896 (K). EROMANGA: Happy Land, east of Mt. Nompoun-Oumpan, Bernardi 13298 (p holotype).

Ophiorrhiza brachyantha, proposed here as new, seems most closely related to *O. laxa*, a Fijian endemic. It is hardly separable from that species by means of vegetative characters and especially resembles it in the shape of the leaf blades, the overall form of the stipules, and the type of indument. In floral morphology, however, the Fijian spe-

FIGURE 3. A, *Ophiorrhiza peploides*, portion of cleared leaf mesophyll showing two bundles of raphid crystals, × 350, from Smith 9329. B-E, *O. rupestris*, all from McKee 19879; B, distal node showing stipule, × 10; C, portion of inflorescence with flowers and fruits, × 4; D, flower, × 10; E, leaf, × 1. F & G, *O. brachyantha*, both from Bernardi 13298; F, inflorescence, × 2; G, flower, × 10. s = stipule. cl = calyx lobe.



most often, in dark, humid forests. The flowers are fragrant and usually white, rarely pink or purplish. The fruits are usually green, occasionally purple-tinged. Flowering and fruiting specimens have been gathered throughout the year.

LOCAL NAMES AND USES: A number of local names have been recorded for this species: *asiasi-ni-vatu* (*Degener 15094*), *lera*, *lerandamu* (Parham, 1972, cited above), *ndi-ndi-ndi* (*Gillespie 4061*), *ndre-ndre-wai*, *thandrai* (*H. B. R. Parham 224*), *todaolo* (*Yeoward 3*), *u-thu-ni-rau-rau* (*H. B. R. Parham 224*). H. B. R. Parham reported that parts of this plant are used by Fijians as a hair-wash and perhaps are also eaten.

Fiji. VITI LEVU: MBA: Mountains between Lautoka and Loloti, *Greenwood 73* (K); escarpment north of Nandarivalu, *Smith 6276* (A, BISH, K, NY, US); vicinity of Nandarivalu, *Gibbs 607* (BM), *Gillespie 4061* (BISH, K, UC), *im Thurn 76* (K), *Vaughan 3376* (BM, K); Navai, *im Thurn 202* (BM, K). NANDRONGA & NAVOSA: Korolevu, *Krauss*, Jan. 1958 (BISH); Nokonoko District, *H. B. R. Parham 224* (BM); vicinity of Vatukarasa, *O. & I. Degener 32119* (BISH, NY). SERUA: Trail to Mt. Gordon, *Fiji Dept. Agr. 14494* (BISH, SUVA); vicinity of Ngaloa, *Smith 9329* (BISH, GH, K, NY, P, SUVA, UC, US), *Degener 15094* (A, K, NY, US). NAMOSI: Vicinity of Namosi, *Gillespie 2618* (BISH), *2706* (BISH). RA: Mountains near Penang, *Greenwood 73-A* (K). NAITASIRI: Wainimala River above Mataniwailavu, *Fiji Dept. Agr. 18029* (MASS, SUVA); vicinity of Korovou Village, *Fiji Dept. Agr. 14018* (BISH, K, SUVA); waterfall on Savura River, *Vaughan 3265* (BM, K); vicinity of Nasinu, *Gillespie 3589* (BISH, UC). TAILEVU: Nukurua Creek, *Fiji Dept. Agr. 1025* (A, SUVA). REWA: Mt. Korombamba, *Meebold 16482* (BISH, K); vicinity of Lami, *Gillespie 4577* (BISH, UC), *Tothill 240* (K), *241* (K); Vatuwangga, near Suva, *Yeoward 3* (K); vicinity of Suva Bay, *Setchell & Parks 15131* (UC). VIII LEVU, without further locality, *Graeffe 34* (BM), *1619* (GH). KANDAVU: Namalata isthmus region, *Smith 43* (BISH, NY). OVALAU: Hills southeast of Mbureta River, *Smith 7423* (BISH, GH, K, US); vicinity of Levuka, *Gillespie 4462* (BISH, NY, UC), *Prince*, in 1898 (GH); Ovalau, without further locality, *Graeffe 1539* (K), *1590* (K), *Graeffe* (NY), *Le Guillou*, Oct. 1838 (P), *MacGillivray*, Oct. 1854 (BM), *Milne 50* (K), *U.S. Expl. Exped.* (us 47493 lectotype; isolectotypes at GH, K, NY). KORO: Western slope, *Smith 1069* (BISH, GH, K, NY, UC, US). NGAU: Mt. Vonda, toward Waikama, *Smith 7980* (BISH, GH, K, NY, SUVA, UC, US). VANUA LEVU: MBA: Vicinity of Rukuruku Bay, *H. B. R. Parham 2* (K); Nandi, *Milne 263* (K). MATHUATA: Mathuata Range, north of Natua, *Smith 6754* (A, K, US); Mt. Numbuloa, east of Lambasa, *Smith 6354* (A, BISH, K, P, US), *6355* (A, BISH, K, NY, P, US). THAKAUNDROVE: Mt. Mbatini, *Smith 671* (BISH, GH, K, NY, P, US); vicinity of Savusavu, *Degener & Ordonez 14021* (A, US); Savusavu, Nawena Plantation, *Fiji Dept. Agr. 11529* (BISH, SUVA); Maravu, near Salt Lake, *Degener & Ordonez 14132* (A, BISH, K, NY, UC, US), *14216* (A, BISH, K, NY, UC, US); trail from Mbiangunu to Drayton Peak, *Bierhorst F136* (MASS); Natewa Peninsula, hills west of Mbutha Bay, *Smith 823* (BISH, GH, K, NY, P, US). TAVEUNI: Vicinity of Somoamo, *Seemann 228* (BM, GH, K); vicinity of Wairiki, *Gillespie 4400.1* (BISH, SUVA, UC, US), *4680* (BISH); Mt. Manuka, east of Wairiki, *Smith 8333* (BISH, GH, K, NY, SUVA, UC, US). MATUKU: Without further locality, *Milne 106* (K), *Moseley*, July, 1874 (K). FIJI, without further locality, *Harvey*, Nov. 1855 (BM, GH, K), *Home* (BM), *Horne 130* (GH, K).

This species of *Ophiorrhiza* is one of the most distinct in the genus, differing from other Pacific taxa in its usually glabrous, broadly infundibular corollas with proportionately long lobes, its exerted

appressed hairs; corolla narrowly infundibular, the tube (4.6—) 8.2—11.8 (14.2) mm. long, 0.5—0.8 mm. in diameter at middle, glabrous without or rarely puberulent toward base with scattered, short, white hairs, glabrous within except villose at corolla throat with weak, white hairs up to 1.2 mm. long, the lobes ovate to elliptic, 2—3.6 mm. long, 1—2 mm. broad, acute at apex, entire at margin, glabrous without, puberulent within with short, white, glandular hairs; stamens inserted at corolla throat, the filaments filiform, up to 0.3 mm. long, the anthers exerted, more or less basifixed, oblong-linear, 1.3—1.5 mm. long, 0.3—0.4 mm. broad; ovary subglobose, 1—1.2 mm. long, 0.8—1.7 mm. broad, glabrous to densely puberulent with minute, white to stramineous hairs, capped by a 2-lobed disk up to 0.8 mm. high; style filiform, (6.2—) 7.8—14.8 mm. long, about 1 mm. in diameter, glabrous; stigma barely exerted, capitate, 2-lobed, about 0.3 mm. long, 0.5—1.2 mm. broad, minutely glandular on upper surface; fruits mitriform, 1.9—3.2 mm. long at middle, 5.1—8.2 mm. broad, glabrous to finely puberulent, red-brown when dry, capped by persistent calyx lobes and disk.

TYPE LOCALITY: Gray's description of *Ophiorrhiza laxa* was based on a collection made by Milne and specimens obtained during the course of the U.S. Exploring Expedition. As noted under the preceding species, an Exploring Expedition collection should be taken as the lectotype, since those collections form the subject of Gray's paper. In the case of *O. laxa*, a number of Exploring Expedition sheets have been annotated *O. laxa* by Gray, but not all fit his description. As lectotype I designate one specimen at the U.S. National Herbarium (US 47491), the place of deposit of the first set of Exploring Expedition collections. Another "*laxa*" specimen found there (US 47490) falls within my concept of *O. leptantha*. One other Exploring Expedition specimen (NY) fits Gray's description of *O. laxa* but is evidently not part of the same collection as the lectotype and therefore cannot be considered an isotype. Gray ascribed this species to the Fiji Islands without further locality; all of the above mentioned Exploring Expedition specimens bear the locality "Ovolau, Feejee Islands," and therefore Ovalau is probably the correct place of collection.

The holotype of *Ophiorrhiza leptantha* var. *yasawana* is *St. John 18126* (BISH), collected on Waya Island in the Yasawa group of the Fijian archipelago. *St. John* gives the locality as Olo Creek, north of Yalombi, at an altitude of 800 ft.

DISTRIBUTION: Endemic to Fiji and found throughout that archipelago, although relatively rare on the island of Vanua Levu. *Ophiorrhiza laxa* varies in habit from a small herb to a slender shrub or even a liana. It is found at elevations from sea level to about 1,200 m. in open areas, or more usually in dense, humid forests. The corol-

O. laxa has been recognized as distinct by some authors but combined with *O. leptantha* by others. In reviewing essentially all the available collections of this complex in Fiji, I have been able to place nearly all the specimens in one or the other taxon with reasonable certainty. Intermediate collections do exist, but they are few in number and after critical examination they can usually be confidently referred to one or the other species. The concept of *O. laxa* here adopted is to a large extent based on such generalized features as the comparatively slender and lax branchlets and inflorescences, the fine, white indument of the calyx and hypanthium, the relatively short corolla tubes and styles, and the insertion of the stamens at the corolla throat, which is always puberulent with a ring of white hairs. Correlation of the somewhat generalized vegetative characters with more specific features of floral morphology (e. g. the position of the stamens) would suggest a reasonable degree of genetic isolation from *O. leptantha*.

Examination of the holotype of *Ophiorrhiza leptantha* var. *yasawana* shows this collection to be quite unlike typical *O. leptantha* but in no way separable from *O. laxa* as here understood.

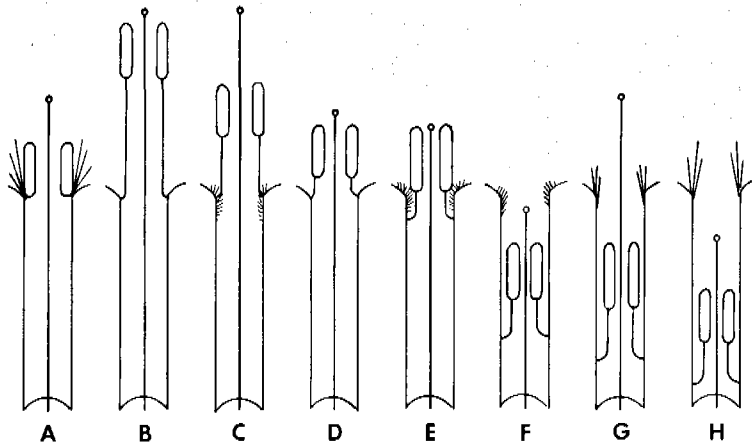


FIGURE 5. A-H, Diagrams of corollas from representative collections of *Ophiorrhiza laxa* and *O. leptantha* showing relative position of anthers and stigmas. A, *O. laxa*, from Degener & Ordonez 13587. B-H, *O. leptantha*: B, from Degener & Ordonez 13819; C, from Smith 814; D, from Smith 6453; E, from Degener & Ordonez 14008; F, from Fiji Dept. Agr. 1020; G, from *im Thurn* 359 p. p.; H, from U.S. Expl. Exped.

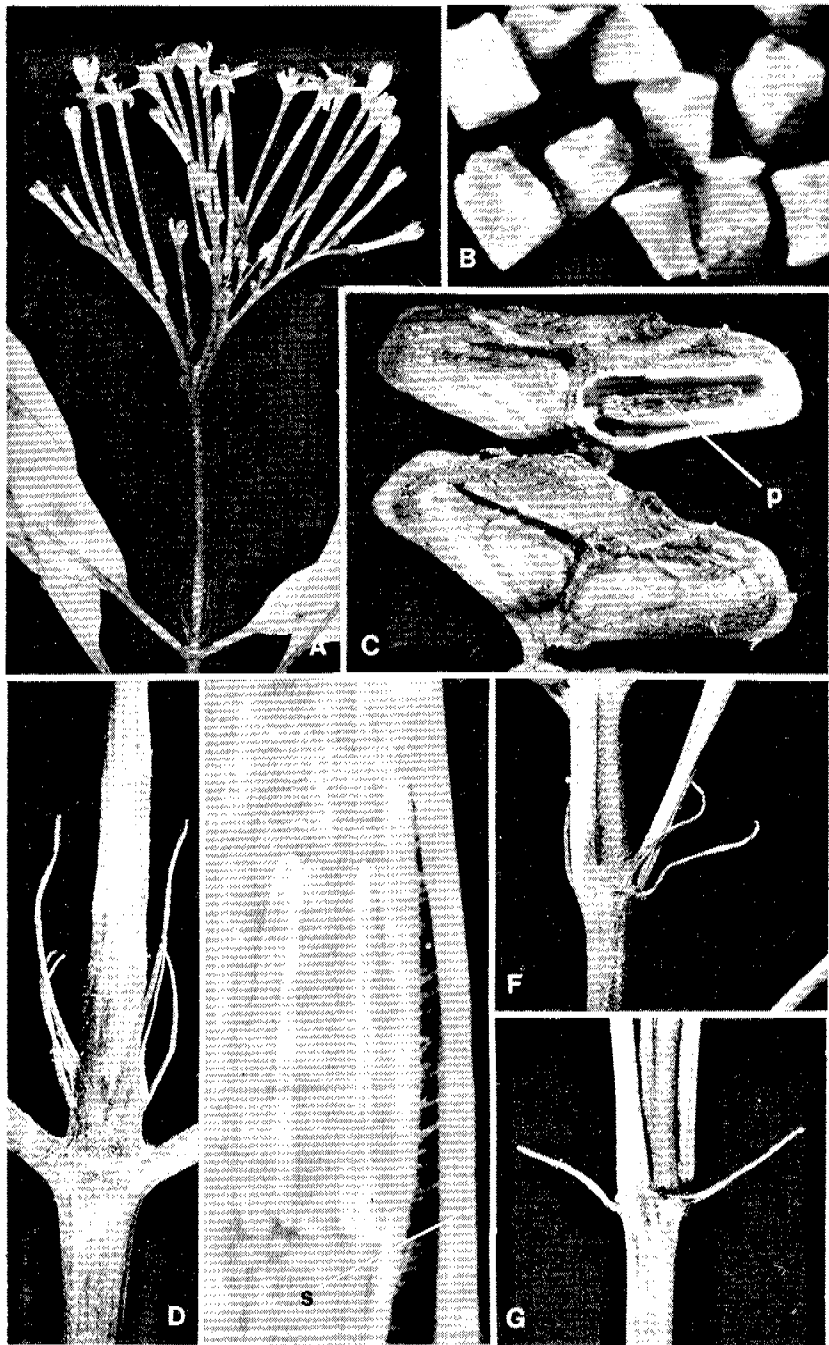
long, 1.4—1.8 mm. broad, densely puberulent with white to orange hairs, capped by a 2-lobed disk up to 0.8 mm. high; style filiform, (15—) 18—20.4 mm. long, about 1 mm. in diameter, glabrous; stigma short-clavate to capitate to somewhat peltate, usually included or barely exerted, 0.5—1.4 mm. long, 0.5—1 mm. broad, finely puberulent with glandular hairs on upper surface; fruits mitriform, 2.4—3.6 mm. long at middle, 6.2—10.6 mm. broad, puberulent with scattered, stramineous to white hairs, drying dark red-brown, capped by persistent calyx lobes and disk.

TYPE LOCALITY: Gray based his description of *Ophiorrhiza leptantha* on a collection made by Harvey and others obtained during the course of the U.S. Exploring Expedition. Since Gray's paper deals with the plants collected during that Expedition, one of the latter collections should be considered the lectotype. An Exploring Expedition specimen (us 47492) identified by Gray as *O. leptantha* agrees well with his description and is accepted here as the lectotype. Gray cited *O. leptantha* as found in the Fiji Islands without further locality; the lectotype bears the notation "Ovolau, Feejee Islands," which is probably the correct type locality. Other Exploring Expedition sheets (K, P) fall within my concept of *O. leptantha*, but they differ somewhat from the lectotype; they are probably not part of the same collection and therefore should not be considered isolectotypes. Those sheets bear the locality "Feejee Islands" only.

DISTRIBUTION: Common throughout the Fijian archipelago and also occurring on the island of Futuna, one of the Horne Islands. A perusal of specimens determined as *Ophiorrhiza leptantha* from the Solomon Islands indicates that those collections are referable to a different taxon. Similarly, *O. leptantha* is unknown in the New Hebrides, to which it has been ascribed. One Graeffe collection labeled "Samoa" seems referable to *O. leptantha*, although the genus is not reliably recorded in the Samoan flora. Since Graeffe is known to have collected in Fiji, and since others of his collections are suspected to have been mislabeled, I am inclined to consider the one Samoan collection of *O. leptantha* as being of probable Fijian origin.

In elevation, this species ranges from near sea level to about 1,000 m. It has variously been reported as an herb or sizable shrub common in dense, humid forests or rarely in more open environments. The flowers are fragrant and white varying to pink; the fruits are green before becoming brown upon drying. The calyx and branches of the inflorescences are sometimes purple-tinged. Flowers and fruits have been collected throughout the year.

LOCAL NAMES AND USE: In Fiji the local names *mbulu* (Smith 370), *ndomale* (St. John 18928), and *ndranikau-ni-ula* (Gillespie 2685) have



fruit, the peduncle stout, 25—85 mm. long, glabrous to puberulent with minute, yellow hairs, the pedicels up to 1.5 mm. long, puberulent with minute yellow hairs, the bracts frequent, subulate to setaceous, up to 13 mm. long, up to 0.7 mm. broad at base, glabrous or finely puberulent; calyx lobes coriaceous, deltoid to broadly subulate, 1—2.8 (—3.2) mm. long, 0.3—0.8 mm. broad and somewhat united at base, acute at apex, entire at margin, glabrous to finely puberulent with scattered hairs; corolla hypocrateriform to narrowly infundibular, the tube (15—) 20—38 mm. long, 0.6—1.4 mm. in diameter at middle, puberulent without with scattered, spreading, stramineous to white hairs up to 0.4 mm. long, villose within with lax, white hairs about 0.7 mm. long, these somewhat longer at corolla throat, the lobes more or less ovate, 4—8 mm. long, 0.8—2.8 mm. broad, acute at apex, entire at margin, puberulent within with minute, white, curved hairs up to 0.2 mm. long, these sometimes restricted to margin, puberulent like tube without; stamens inserted well within corolla tube, the filaments filiform, 0.5—0.8 mm. long, the anthers included, more or less basifixed, oblong-linear, about 2—2.5 × 0.5 mm.; ovary subglobose, 1—1.2 mm. long, 1.2—2 mm. broad, capped by a 2-lobed disk about 0.5 mm. high, puberulent with minute, scattered hairs; style filiform, about as long as corolla tube or slightly longer, about 0.2 mm. in diameter, glabrous to finely puberulent with scattered, minute, white hairs below stigma; stigma exserted, short-clavate to capitate or subpeltate, 2-lobed, up to 1 mm. long, 1—2 mm. broad, essentially glabrous; fruits mitriform, 2.5—4.5 mm. long at middle, 4—11.2 mm. broad, puberulent with scattered, minute hairs, drying brown to black, capped by the persistent calyx lobes and disk.

TYPE LOCALITY: In his original description of *Ophiorrhiza palauensis*, Valeton cited but one collection, *Raymundus 124* from Koror, without further locality. I have not seen an example of this collection, and Valeton did not indicate its place of deposit. However, with Valeton's detailed description and a number of topotypes at hand, there is no confusion concerning the application of this name.

The type of *Ophiorrhiza palauensis* var. *biseta* Fosberg is *Takamatsu 1272* from Ngatpang, Babelthuap Island, cited below. The holotype (BISH) is a fruiting specimen collected in April, 1936.

DISTRIBUTION: Endemic to the Palau Islands of Micronesia and commonly found as an herb or small shrub in coral-reef forests, on limestone cliffs, or on volcanic rock. Its altitudinal range is from near sea level to about 100 m. The flowers are white and have been gathered throughout the year, as have fruiting specimens.

Caroline Islands. PALAU GROUP: BABELTHUAP ISLAND: Mt. Megilon, *Hosokawa 7118* (A, BISH, US); Ngatpang, *Takamatsu 1272* (BISH holotype of *O. palauensis* var. *biseta*); Aimelik, *Hosokawa 7274* (A, BISH); Itau, south of Me'ebe'ubul, *Fosberg 32406* (US); Tôdal-san, *Hosokawa 7528* (A); Babelthuap Island, without further locality, *Kanehira 1883* (K). **KORAK ISLAND:** Without further locality, *Takamatsu 1154* (BISH). **MADMOSUK ISLET:** Without further locality, *Stone 1300* (BISH). **KOROR ISLAND:**

nervis tertiariis et rete venularum supra immersis subtus prominulis; inflorescentiis multiramosis 8–20-floris sub fructu circiter 1.5×2 cm., pedunculo 5–15 (—50) mm. longo puberulo, pedicellis sub fructu ad 3 mm. longis puberulis, bracteis multis anguste subulatis vel setaceis 3–15 mm. longis, ad medium circiter 0.3 mm. latis, utrinque puberulis; calycis lobis coriaceis deltoideis circiter 1×1 –1.2 mm. apice acutis, integris, puberulis vel glabris; corollae tubo 10–27 mm. longo, ad medium 0.5–1 mm. diametro, extus pilis aurantiacis minutis puberulo, intus pilis albis effusis ad 0.3 mm. longis puberulo; corollae lobis ovatis vel lanceolatis, 2.5–3.5 mm. longis, 1–1.5 mm. latis, apice acutis, integris, extus et intus pilis minutis aurantiacis vel stramineis puberulis; staminibus 5–6 mm. sub corollae fauce insertis, filamentis filiformibus 1–1.5 mm. longis, antheris plus minusve basifixis oblongo-linearibus, circiter 2×0.3 mm.; ovario subgloboso circiter 1.5×2 mm., dense puberulo; stylo filiformi 10–28 mm. longo, circiter 0.2 mm. diametro quasi glabro; stigmatibus ultra corollae tubum ad 3 mm. exserto, 0.5–0.7 mm. longo, 0.7–1 mm. lato, plus minusve capitato vel breviclavato et supra medium bifido, pilis aurantiacis minutis puberulo; fructibus mitriformibus ad medium circiter 2.5 mm. longis, ad 7 mm. latis, fuscis, puberulis, calycis lobis persistentibus coronatis.

TYPE LOCALITY: Two examples of *Lépine 75* are known (both at p). The specimen giving the detailed locality “mountains of Moorea” is designated the holotype. The other specimen is labeled “Tahiti” without further locality, although both specimens definitely appear to be part of the same collection.

DISTRIBUTION: Occurring on the islands of Moorea and Tahiti at elevations of 400–500 m. The species has been recorded as a suffrutescent herb growing in humid valleys along the banks of streams.

LOCAL NAME. Lépine has recorded the name *haepe* for this plant.

Society Islands. MOOREA or TAHITI: Without further locality, *Lépine 75* (P holotype; isotype at P). TAHITI: Without further locality, *Vesco* in 1847 (P), *Vesco* (P).

This new species belongs to the group of Society Island species with mitriform fruits but differs from all other species in that archipelago in its stipules, which are very narrowly subulate to setaceous for most of their length. In this respect, *Ophiorrhiza setosa* is similar to *O. palauensis*, but it differs from that taxon in the characters indicated in my key. The minute orange-yellow indument on the inflorescences of *O. setosa* is similar to that found in *O. nelsonii*, although in the latter species the longer inflorescences have more numerous flowers, and the corolla tubes are longer. The stipules of *O. tahitensis* are occasionally somewhat setaceous toward apex; in *O. setosa*, however, the membranaceous basal portion of each stipule is much smaller. In addition, the indument of *O. tahitensis* consists of hairs which are considerably longer and more scattered.

8. *Ophiorrhiza nelsonii* Seem. Fl. Vit. 126, as *O. nelsoni*. 1866; Drake, III. Fl. Ins. Mar. Pac. 189, as *O. nelsoni*. 1890, Fl. Polynés. Franç. 86, as *O. nelsoni*. 1893. FIGURES 1, I; 2, F & G; 7, D G.

Ophiorrhiza subumbellata var. *glabra* Nadeaud, Enum. Pl. Indig. Tahiti, 53. 1873.

Suffrutescent herb to 0.5 m. high, the indument composed of minute, usually bright yellow to orange hairs up to 0.1 mm. long, the branchlets stout, subterete, 1.4–3 mm. in diameter toward apex, drying dark red-brown; stipules more or less persistent, membranaceous, ovate, 5.5–15 mm. long, 2–5 mm. broad at base, long-acuminate to subulate at apex, often fimbriate or divided to base, glabrous to puberulent with scattered hairs; petioles slender, semiterete to strap-shaped distally, up to 35 mm. long, 0.5–1.5 mm. broad at middle; leaf blades chartaceous to membranaceous, drying dark green above, bright yellow to orange beneath, ovate to elliptic to obovate, 9–19.5 cm. long, 2.8–6 cm. broad, acuminate at apex, decurrent on petiole at base, entire at margin, glabrous above, glabrous to puberulent beneath with minute stramineous to orange hairs, these often restricted to costa and secondary nerves, the costa prominent, plane to canaliculate above, raised and rounded beneath, the secondary nerves spreading, subparallel, 12–20 mm. per side, plane above, raised and rounded beneath, the tertiary nerves and veinlets plane above, prominulous beneath; inflorescences congested, freely branched, with (9–) 16–60 flowers, 7–12 cm. long and 3–10.5 cm. broad at anthesis, about 6.5 cm. long and 3.5 cm. broad in fruit, the peduncle stout, 12–55 mm. long, the pedicels up to 4 mm. long, the bracts frequent, setaceous to narrowly subulate, 5–20 mm. long, 0.2–0.6 mm. broad, acute at apex, glabrous to finely puberulent; calyx lobes coriaceous, deltoid, 0.7–1.5 mm. long, 0.5–0.7 mm. broad at base and somewhat united, entire at margin, glabrous to finely puberulent; corolla narrowly infundibular to somewhat hypocrateriform, the tube 27–48 mm. long, 0.5–1.8 mm. in diameter at middle, glabrous or puberulent without with stramineous to orange hairs up to 0.2 mm. long, glabrous within except puberulent below stamens with white, lax hairs up to 0.8 mm. long, the lobes ovate to elliptic, 2.7–5.5 mm. long, 1.5–3 mm. broad, acute at apex, entire at margin, glabrous or puberulent without, densely puberulent within with minute, yellow to white, glandular hairs; stamens inserted about 5 mm. below corolla throat, the filaments filiform, up to 2 mm. long, the anthers included, subbasifixed, oblong-linear, 2.5–3 × 0.2–0.5 mm.; ovary subglobose, about 1 mm. long,

FIGURE 7. A—C, *Ophiorrhiza setosa*: A, fruiting inflorescence showing setaceous bracts, × 2, from *Lépine* 75; B, node with bifid stipule, × 4, from *Lépine* 75; C, distal portion of corolla, × 4, from *Vesco* in 1847. D—G, *O. nelsonii*: D, node with fimbriate stipule, × 4, from *Lépine* 77 p. p.; E, glabrous corolla tube, × 40, from *MacDaniels* 1674; F, puberulent corolla tube, × 40, from *MacDaniels* 1601; G, portion of corolla interior showing two stamens, indument, and style, × 20, from *MacDaniels* 1728. s = stipule. st = style.

material which I have examined the stipules may also be entire and setaceous at apex as well as fimbriate. The species is more definitely characterized by its comparatively robust habit, stout branchlets, many-flowered inflorescences, minute, yellow-orange indument, and the lower surfaces of the leaf blades, which often dry with a distinct orange cast. In these features *O. nelsonii* differs from *O. tahitensis* and the other species of *Ophiorrhiza* in the Pacific.

The type specimen of *Ophiorrhiza nelsonii* has puberulent corolla tubes, but many collections differ in having tubes which are glabrous, among which is the type of *O. subumbellata* var. *glabra*. Such collections do not otherwise differ significantly from the holotype of *O. nelsonii* and are here considered referable to the same species. Since it has been necessary to recognize considerable variation in indument within other species (e.g. *O. leptantha*), variation in the same character in *O. nelsonii* hardly seems to justify formal taxonomic recognition of infraspecific taxa.

9. *Ophiorrhiza tahitensis* Seem. Fl. Vit. 127. 1866; Drake, Ill. Fl. Ins. Mar. Pac. 189. 1890, Fl. Polynés. Franç. 87. 1893.

FIGURES 1, C; 2, H; 8, A—D.

Ophiorrhiza subumbellata var. *ciliata* Nadeaud, Enum. Pl. Indig. Tahiti, 53. 1873.

Suffrutescent herb to 0.5 m. high, the indument composed of white to stramineous to ferruginous, curved hairs up to 0.5 mm. long, rarely lacking, the branchlets subterete, 1—2 (—2.5) mm. in diameter toward apex, drying pale to dark red-brown; stipules caducous or persistent, membranaceous, ovate to somewhat deltoid, (1.5—) 2.5—10 (—12) mm. long, 1.5—4 mm. broad, long-acuminate to setaceous at apex or often fimbriate or sometimes divided to base, glabrous to puberulent with scattered hairs; petioles slender, semiterete to strap-shaped distally, 2—18 mm. long, 0.5—1 mm. broad at middle; leaf blades chartaceous to submembranaceous, drying dark green above, paler beneath, ovate to elliptic to obovate, 4.5—11.5 cm. long, 1.8—4.5 cm. broad, acute to acuminate at apex, decurrent on petiole at base, entire at margin, glabrous to puberulent above with scattered hairs, or these restricted to base and margin, puberulent beneath with scattered hairs, or these more often restricted to costa and secondary nerves, the costa conspicuous, plane to canaliculate above, raised and rounded beneath, the secondary nerves spreading, 9—18 per side, plane to prominulous above, raised and prominent to prominulous beneath, the tertiary nerves and veinlets plane above, prominulous beneath; inflorescences compact, freely branched, with 3—12 (—15) flowers, 3—12 (—15) cm. long and 2—8 cm. broad at anthesis, 2—4.5 cm. long and 1—3 cm. broad in fruit, the peduncle 10—35 (—40) mm. long, puberulent to glabrous, the pedicels up to 3 mm. long, the bracts frequent, setaceous to broadly subulate, often divided, up to 16 mm. long, 0.3—1 (—1.5) mm. broad at middle, glabrous to puberulent with a few scattered

In many respects *Ophiorrhiza tahitensis* is similar to *O. nelsonii*, with which it seems closely related. Seemann distinguished *O. tahitensis* from *O. nelsonii* by the entire stipules of the former taxon versus the fimbriate stipules of the latter. Such distinctions hold when only the type collections are compared, but here the definition of *O. tahitensis* is expanded to include collections with both fimbriate and entire stipules; both stipule types have been found to occur on the same specimen with some frequency. This broader interpretation of *O. tahitensis* also encompasses the type collection of *O. subumbellata* var. *ciliata* Nadeaud, which, except for its relatively broad inflorescence bracts, is hardly separable from *O. tahitensis*. *Ophiorrhiza nelsonii* is readily distinguished from *O. tahitensis* by the characters mentioned in my key, but especially by the more minute, orange-yellow indument of the former species, its more robust inflorescences with more numerous flowers, and its usually larger leaf blades which often dry with an orange cast beneath.

Ophiorrhiza tahitensis is suggestive of *O. longituba*, but in the latter species the lower surfaces of the leaf blades are glabrous, the stipules longer, the inflorescence bracts narrower, the stigma shorter, the fruits longer, and the branchlets glabrous. *Ophiorrhiza subumbellata*, *O. orofenensis*, and *O. scorpioidea* differ from *O. tahitensis* in their subglobose fruits, *O. solandri* differs in its more lax, fewer-flowered inflorescences, *O. platycarpa* in its much smaller stipules and more slender branchlets, and *O. setosa* in its finer indument and narrower stipules.

Like that of *Ophiorrhiza nelsonii*, the indument of the corolla tubes of *O. tahitensis* is quite variable. In some collections, including the type, the corolla tubes are glabrous, but in a few others they are distinctly puberulent. Considering the variation in indument encountered in other species, it seems best not to regard collections with glabrous or puberulent corolla tubes as constituting separate formal taxonomic groups, although it may prove, when more material is available for study, that the recognition of two forms is justifiable.

10. ***Ophiorrhiza longituba*** J. W. Moore in Bishop Mus. Bull. 102: 44. 1933. FIGURES 8, E & F; 9, A.

Subligneous herb to 1 m. high, the indument composed of occasional scattered hairs or lacking, the branchlets stout, subterete, 1.5–2 mm. in diameter toward apex, drying dark brown; stipules caducous, membranaceous, ovate to deltoid, 10–20 mm. long, 3–4 mm. broad, long-acuminate to subulate at apex, often divided about halfway to base, glabrous; petioles stout, semiterete, 5–12 mm. long, about 1 mm. broad at middle; leaf blades chartaceous, drying dark green

above, paler beneath, ovate to elliptic, 5–8 cm. long, 1.5–3 cm. broad, acute to acuminate at apex, decurrent on petiole at base, entire at margin, glabrous on both surfaces, the costa prominent, plane to canaliculate above, raised and rounded beneath, the secondary nerves spreading, 14–16 per side, prominulous on both surfaces, the tertiary nerves and veinlets plane to impressed above, somewhat prominulous beneath; inflorescences freely branching, with 5–10 flowers, about 6.5 cm. long and up to 2 cm. broad at anthesis, about 4 × 2.5 cm. in fruit, the peduncle 5–22 mm. long, the pedicels 1–5 mm. long, glabrous or finely puberulent with minute orange hairs, the bracts narrowly subulate, 10–12 mm. long, about 0.3 mm. broad at middle, acute at apex, glabrous; calyx lobes coriaceous, sublanceolate, about 1.5 mm. long and 0.7 mm. broad, acute at apex, somewhat fused at base, entire at margin, glabrous; corolla hypocrateriform to narrowly infundibular, often somewhat constricted at throat, the tube 35–42 mm. long, about 1 mm. in diameter at middle, glabrous without, glabrous within except puberulent for about 5 mm. below stamens with occasional white hairs up to 0.3 mm. long, the lobes long-elliptic, 4–5 mm. long, about 1.5 mm. broad, acute to obtuse at apex, entire at margin, densely puberulent within with minute white hairs, glabrous without; stamens inserted about 4 mm. below corolla throat, the filaments filiform, about 1 mm. long, the anthers included, dorsifixed about 0.5 mm. above base, oblong-linear, 2–2.5 mm. long, about 0.3 mm. broad; ovary subglobose, about 1.5 × 1–1.5 mm., capped by a 2-lobed disk about 0.2 mm. high; style filiform, about as long as corolla tube, about 0.3 mm. in diameter; stigma barely exerted, clavate, bifid above middle, about 1 × 0.5 mm., essentially glabrous; fruits mitriform to triangular, 3–3.5 mm. long at middle, 8–9 mm. broad, glabrous, pale brown when dry, capped by the persistent calyx lobes and disk.

TYPE LOCALITY: The type collection is *Moore 484*, from Mt. Temchani, Raiatea, cited below. It was collected at an elevation of about 450 m., Jan. 1, 1927, and includes both flowers and fruits.

DISTRIBUTION: Endemic to the island of Raiatea and thus far known only from the type collection. Like other Pacific taxa of the genus, *Ophiorrhiza longituba* is found in wet, shaded areas along the banks of streams; Moore reported that the flowers of this species are pink.

Society Islands. RAIATEA: Mt. Temchani, *Moore 484* (BISH 406401 holotype; isotypes at BISH).

FIGURE 8. A–D, *Ophiorrhiza tahitensis*; A, distal portion of corolla, × 4, from Quayle 65; B, portion of lower surface of leaf blade showing midrib and indument, × 30, from Lay & Collie in 1826; C, fruiting inflorescence with bracts, × 2, from Nadeaud 353-B; D, two nodes with stipules, × 4, from Nadeaud 353-B. E & F, *O. longituba*, both from Moore 484; E, node with stipule, × 4; F, portion of glabrous lower surface of leaf blade, × 30.

puberulo; fructibus mitriformibus, ad medium 2.5—3 mm. longis, 6—7.5 mm. latis, fuscis, pilis dispersis puberulis, calycis lobis persistentibus coronatis.

TYPE LOCALITY: As type I designate a Whitney Expedition specimen, *Quayle 123*, which bears mature fruits. The locality given is "Tahiti, Vairao, R. Nohu, rock wall at bottom of canyon opposite open cave."

DISTRIBUTION: Endemic to Tahiti, although from a number of uncertain localities on that island. *Ophiorrhiza platycarpa* has been found as an herb growing along watercourses at an altitude of about 200 m., as far as indicated. The corollas are white. Fruiting material has been gathered in October.

Society Islands. TAHITI: VAIRAO: Nohu River. *Quayle 123* (*Whitney Exped. 270*) (BISH holotype; isotype at BISH). TAHITI, without further locality, *Lay & Collie*, March—April, 1826 (BM). *Pancher (?) 15* (P). *Vesco* in 1847 (P).

In the size and shape of its stipules and leaf blades, its obscurely puberulent indument, and the size of its inflorescences, this new species is very similar to *Ophiorrhiza subumbellata*, to which it seems very closely related. However, the fruits of the latter species are subglobose, the corolla tubes may be somewhat shorter, and the anthers are more decidedly dorsifixed. The two species are difficult to separate in flowering condition. *Ophiorrhiza platycarpa* is distinct from *O. tahitensis*, *O. nelsonii*, and *O. longituba* in that those species all have stouter branchlets and much larger stipules, among other characters.

12. *Ophiorrhiza solandri* Seem. Fl. Vit. 127. 1866; Drake, 111. Fl. Ins. Mar. Pac. 189. 1890, Fl. Polynés. Franç. 88. 1893.

FIGURES 9, D; 10, A & B.

Ophiorrhiza rugosa Solander ex Seem. Fl. Vit. 127, pro syn. 1866; Solander ex Drake, 111. Fl. Ins. Mar. Pac. 189, pro syn. 1890.

Ophiorrhiza torrentium Nadeaud, Enum. Pl. Indig. Tahiti, 54. 1873.

Ophiorrhiza scorpioidea sensu Setchell in Univ. Calif. Publ. Bot. 12: 210. 1926; non Nadeaud.

Subligneous herb to 40 cm. high, the indument composed of stramineous to ferruginous, curved hairs up to 0.1 mm. long, the branchlets slender, subterete, up to 1.5 mm. in diameter toward apex, drying red-brown; stipules caducous, coriaceous to somewhat membranaceous, deltoid to more or less ovate, up to 3 mm. long, rarely longer, obtuse to acute to acuminate at apex, rarely divided, glabrous to finely puberulent with scattered hairs; petioles slender, semiterete, 1—12 mm. long, up to 0.5 mm. broad at middle; leaf blades chartaceous to membranaceous, distinctly rugose when dry, dark green above, paler

beneath, lanceolate to elliptic to oblanceolate, 3—11.8 cm. long, 1—3 cm. broad, acute to acuminate at apex, decurrent on petiole at base, entire at margin, glabrous to puberulent above with minute, scattered hairs or these restricted to costa and base, glabrous to puberulent beneath with hairs restricted to costa and secondary nerves, the costa conspicuous, prominulous to plane or canaliculate above, prominently raised and rounded beneath, the secondary nerves spreading, 8—20 per side, sharply raised above, prominulous beneath, the tertiary nerves and veinlets raised above, faintly prominulous beneath; inflorescences narrow, lax, unbranched or branched only once, with 2—7 flowers, 2—8 cm. long, up to 1.5 cm. broad at anthesis, 4—12 cm. long, up to 3.5 cm. broad in fruit, the peduncle slender, lax, 2.5—9.5 cm. long, the pedicels up to 10 mm. long, the bracts frequent but caducous, narrowly subulate to setaceous, 2—7 mm. long, about 0.2 mm. broad toward base, glabrous; calyx lobes coriaceous to chartaceous, deltoid to somewhat ovate, 0.3—1 mm. long, 0.3—0.5 mm. broad at base and somewhat united, acute at apex, entire at margin, essentially glabrous; corolla narrowly infundibular, the tube up to 20 mm. long, up to 1 mm. in diameter at middle, glabrous without, glabrous within except puberulent below the stamens with scattered, white hairs up to 0.3 mm. long, the lobes elliptic to ovate, 2.5—3.5 mm. long, 1—1.5 mm. broad, obtuse to acute at apex, entire at margin, glabrous without, puberulent within with minute, white, glandular hairs; stamens inserted 3—5 mm. below corolla throat, the filaments filiform, 0.5—2 mm. long, the anthers included, more or less dorsifixed about 0.5 mm. above base, oblong-linear, up to 2 mm. long, about 0.2 mm. broad, the locules free below point of attachment; ovary subglobose, about 1 × 1.5 mm., capped by a 2-lobed disk up to 0.3 mm. high, glabrous to finely puberulent; style filiform, up to 21 mm. long, about 0.1 mm. in diameter, glabrous except finely puberulent below stigma; stigma clavate, bifid above middle, about 1 × 0.3 mm., finely puberulent with minute, stramineous to orange glandular hairs; fruits mitriform, 1.8—3 mm. long at middle, 5—6.5 mm. broad, glabrous, drying red-brown, capped by persistent calyx lobes and disk.

TYPE LOCALITY: Seemann based his description of *Ophiorrhiza solandri* on a single Tahitian specimen collected by Banks and Solander during the first Pacific voyage of Captain Cook. A notation on the holotype (BM) ascribes the collection to Tahiti without further locality.

The type of Nadeaud's species *Ophiorrhiza torrentium* was collected by him (no. 356) in May, 1859, on rocks in streams at "Tearapau," Tahiti, at an elevation of about 1,100 m. The single known specimen (P) is in flower.

FIGURE 9. A, *Ophiorrhiza longituba*, fruiting inflorescence, × 2, from Moore 484. B & C, *O. platycarpa*, both from Quayle 123; B, node with stipule, × 10; C, fruiting inflorescence with bracts, × 2. D, *O. solandri*, fruiting inflorescence, × 2, from MacDaniels 1585. s = stipule.

base of the leaf blade, 1.6—12 (—20) mm. long, 0.5—1 mm. broad at middle; leaf blades chartaceous, drying dark green above, paler beneath, ovate to lanceolate to elliptic to obovate, 3—11 cm. long, 1.2—2.8 cm. broad, acute to acuminate at apex, decurrent on petiole at base, entire at margin, glabrous above, glabrous to finely puberulent beneath with hairs restricted to costa or margin, the costa prominent, plane to somewhat raised to canaliculate above, raised and rounded beneath, the secondary nerves spreading, 9—16 per side, plane to prominulous above, prominulous to raised and rounded beneath, the tertiary nerves and veinlets plane above, discernible beneath; inflorescences at most 3-branched, with 5—18 flowers, 3—5 cm. long and about 1.5 cm. broad at anthesis, 1—2.5 cm. long and 1.5—3.5 cm. broad in fruit, the peduncle 3—10 mm. long, the pedicels not more than 1.5 mm. long at anthesis, up to 5 mm. long in fruit, the bracts conspicuous, narrowly subulate to setaceous, 5—13.5 mm. long, up to 0.5 mm. broad at base, acuminate at apex, glabrous to finely puberulent; calyx lobes coriaceous, deltoid, up to 1 mm. long, about 0.5 mm. broad at base, acute at apex, entire at margin, glabrous to finely puberulent; corolla narrowly infundibular, the tube up to 16 mm. long, up to 0.7 mm. in diameter at middle, glabrous to finely puberulent without with minute hairs near base, glabrous within except puberulent below stamens with a few scattered hairs up to 0.2 mm. long, the lobes more or less ovate, 1.5—3 mm. long, 1—2 mm. broad, acute at apex, entire at margin, essentially glabrous without, finely puberulent within with minute, white hairs; stamens inserted 1—4 mm. below corolla throat, the filaments filiform, 0.5—1 mm. long, the anthers included, dorsifixed 0.5—1 mm. above base, oblong-linear, 1.5—2.5 × 0.2—0.3 mm., the locules free below point of attachment; ovary subglobose, 1—1.7 mm. long, 0.7—1.6 mm. broad, capped by a 2-lobed disk up to 0.3 mm. high, essentially glabrous to finely puberulent with a few scattered, minute hairs; style filiform, about as long as corolla tube, up to 0.1 mm. in diameter, glabrous except for a few scattered hairs below stigma; stigma barely exerted, clavate, about 1 mm. long and 0.3 mm. broad, puberulent with minute, glandular hairs; fruits subglobose, rarely somewhat laterally compressed, 2—4 mm. long, 2.5—4.5 mm. broad, glabrous, drying brown, capped by the persistent calyx lobes and disk.

TYPE LOCALITY: Forster based his brief description of *Ophiorrhiza subumbellata* on a single Tahitian collection made during the second Cook Pacific voyage. He gave the locality only as Tahiti, and this is indicated on the two available Forster collections at BM and K. The former specimen I designate the lectotype; this bears the additional notation "Capt. Cook, 1794," but this date is too late for any of the Cook voyages and may be the date of accession by the herbarium.

Nadeaud based his description of *Ophiorrhiza fruticulosa* on his own collection (no. 354) from the high valleys of Pirae and Haamuta at an altitude of about 800 m. *Nadeaud 354* is represented by two specimens (P), which may be considered together as constituting the

holotype. One of the sheets bears the locality cited by Nadeaud, although it is barely legible.

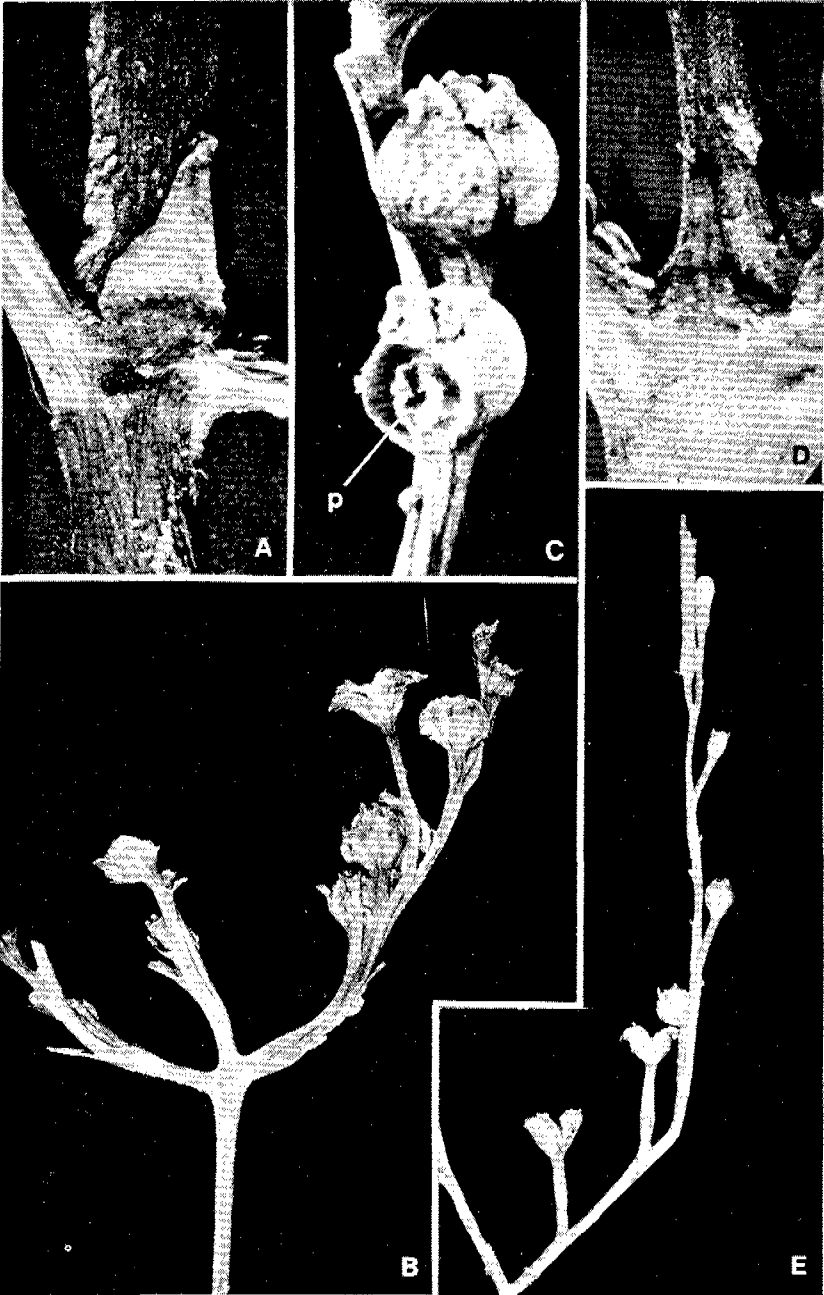
DISTRIBUTION: Probably endemic to the island of Tahiti and occurring at elevations above 800 m. This species has been observed as an herb or a small shrub in shaded fern forests or more open habitats. Flowering and fruiting specimens have been collected in June and November. One U.S. Exploring Expedition collection (US) bears "Samoa" as a locality, but since this material is essentially identical with the collections of *Ophiorrhiza subumbellata* from Tahiti, it may well be of Tahitian origin also. As previously stated, it is known that the localities cited on the labels of the Exploring Expedition are not overly reliable. Moreover, the flora of Samoa is reasonably well understood, and *Ophiorrhiza* is not known with certainty in that archipelago.

Society Islands. TAHITI: PIRAE: High valleys of Pirae and Haamuta. *Nadeaud 354* (p holotype of *O. fruticulosa*). **MOHINA:** Aorai, *Grant 3727* (BISH); Ahonu Valley, *Grant 4424* (BISH). **TAHITI,** without further locality, *J. R. & G. Forster* (BM lectotype; isolecotype at κ), *Grant 3527* (BISH), *Lay & Collie*, March April, 1826 (BM), *U.S. Expl. Exped.*, p. p. (US 77669 "Samoa"), *Vesco* in 1847 (P).

Ophiorrhiza subumbellata was the first Pacific species of this genus to be described, and it is one of the most easily recognized by the combined characters of subglobose fruits, small stipules, and compact, relatively few-flowered inflorescences. *Ophiorrhiza orofenensis* and *O. scorpioidea* share with *O. subumbellata* the character of subglobose fruits, a feature which is, as far as known, not found elsewhere in the genus. Since all of the species which share this character are found in the Society Islands, they probably represent a group of closely related taxa. From *O. subumbellata*, *O. orofenensis* differs in its stouter branchlets, its secondary nerves which dry with a yellowish color, its longer stipules, and its larger inflorescences with more numerous flowers. In *O. scorpioidea* the inflorescences are also longer, bear more numerous flowers, and are more openly branched.

Ophiorrhiza subumbellata also seems to be related to *O. platycarpa*; in the size of the inflorescences, leaf blades, and stipules the two are essentially identical. However, the fruits of *O. platycarpa* are

FIGURE 10. A & B, *Ophiorrhiza solandri*, both from *Vesco* in 1847; A, inflorescence, × 1; B, rugose upper surface of leaf blade, × 2. C--F, *O. subumbellata*; C, inflorescence with bracts, × 2, from *Grant 3727*; D, upper surface of leaf blade, × 2, from *Grant 3727*; E, node with stipule, × 10, from *Vesco* in 1847; F, interior of distal portion of corolla showing two stamens, style, and stigma, × 15, from *Grant 4424*. G, *O. orofenensis*, upper surface of leaf blade showing pale secondary nerves, × 2, from *St. John & Fosberg 17011*. st = style.



beneath, ovate to elliptic to obovate, 7—13 cm. long, (1.5—)2—4.5 cm. broad, acuminate at apex, obtuse to acute and shortly decurrent on petiole at base, entire at margin, glabrous to puberulent above with minute, scattered hairs, glabrous to puberulent beneath with hairs restricted to the costa, the costa conspicuous, plane to canaliculate above, raised and rounded beneath, the secondary nerves spreading, 10—14 per side, more or less prominulous above, more sharply raised beneath, the tertiary nerves and veinlets plane above, discernible beneath; inflorescences open, lax, freely branched, with 25—50 flowers (or these rarely as few as 10), 3—10 cm. long and 6—9 cm. broad at anthesis or in fruit, the peduncle (10—) 40—75 (—90) mm. long, the rachis elongate and delicate, the pedicels up to 3.5 mm. long, the bracts infrequent, narrowly setaceous, up to 5 mm. long, about 0.5 mm. broad at base, acute at apex, essentially glabrous; calyx lobes coriaceous, deltoid to more or less elliptic, 0.4—0.7 mm. long, up to 0.5 mm. broad, acute at apex, entire at margin, essentially glabrous; corolla narrowly infundibular, the tube 13—18.5 mm. long, 0.5—0.7 mm. in diameter at middle, glabrous without, glabrous to finely puberulent within with a few scattered hairs, the lobes more or less ovate, 1.6—2.8 mm. long, 1—1.5 mm. broad, acute at apex, entire at margin, glabrous without, densely puberulent within with small, yellow, glandular hairs; stamens inserted about 3 mm. below corolla throat, the filaments filiform, up to 0.5 mm. long, the anthers included, dorsifixed about 0.3 mm. above base, oblong-linear, up to 2 mm. long, 0.2—0.3 mm. broad, the locules free below point of attachment; ovary subglobose, 1—1.5 × 1 mm., essentially glabrous, capped by a 2-lobed disk about 0.4 mm. long; style filiform, about the same length as corolla tube, about 0.1 mm. in diameter, glabrous; stigma clavate to capitate, about 1 × 1 mm., puberulent with minute glandular hairs; fruits subglobose, 2—3 mm. long, 2.5—3.5 mm. broad, glabrous, drying brown, capped by the persistent calyx lobes and disk.

TYPE LOCALITY: Nadeaud based his description of this species on one of his own collections (no. 355) from the island of Tahiti, at the edge of the Anaorii Plateau, at the base of Papenoo Valley, cited below. This collection is represented by two sheets (P), which may be considered as together constituting the holotype. The type collection was made in July, 1857, at an altitude of 600—1,000 m.

DISTRIBUTION: Endemic to the Society Islands; specimens have been collected on Moorea and at various locations on Tahiti. *Ophiorrhiza scorpioidea* is found as an occasional perennial herb or low shrub in moist forests at elevations from 400 to 1,000 m. Flowering material has been collected at various times of the year; the corollas are red. Fruiting specimens have been gathered in June.

SOCIETY ISLANDS. MOOREA: AFAREAITU: Putoa, *Grant 5388* (BISH). TAHITI: MAHINA: Aorai, *Lépine 76* (P). PAPENOO: Edge of Anaorii Plateau, bottom of Papenoo Valley, *Nadeaud 355* (P holotype). MATAIEA: Lake Vahiria, *MacDaniels 1614* (BISH). TEARUPOO: Mt. Roniu, *Grant 3924* (BISH).