

REVISION OF THE GENUS APONOGETON (APONOGETONACEAE)

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I. THE SPECIES OF MADAGASCAR

SUMMARY

After the treatment of Jumelle in the Flore de Madagascar fam. 23 (1936) substantial additions were made and much material has accumulated. Instead of 7 species of *Aponogeton* distinguished by Jumelle, 11 are recognized in the present revision, among which 3 are new to science. Moreover it was found that the epithet of the laceplant — up till now *fenestralis* — has to be changed in *madagascariensis*. All names have been properly typified; all types could be examined by the author. Quite a few species were observed in cultivation, thanks to generous support from overseas. Special attention has been paid to a detailed examination of the seed structure and that of the embryo and also to flower dimorphism. Descriptions are given of all species and two keys are provided for their identification, one by several gross morphological characters and one based on the characters of the seed and embryo. No attempt has been made to provide a full bibliography of each species; this would have become very complicated by the fact that in former treatments not rarely sheets were assigned to species to which they do not belong. It appeared not useful to cite all these 'sensus' and 'pro partes'. Of each species a distribution map was prepared. All examined sheets are enumerated in an identification list.

INTRODUCTION

As a devoted aquarist I have for many years paid great attention to waterplants useful for the aquarium. In this way I became fascinated by the species of *Aponogeton* which are so commonly used for that purpose. This led me to a detailed study which has great advantages over that of dried specimens. However, the latter are indispensable for their proper naming and furthermore by far not all species are in cultivation. Consequently I had to test my observations with the literature, and of course this led ultimately to the interpretation of herbarium sheets and the typification of the species.

I have split my synthesis of the genus into a number of regional revisions, that of the Malagasy species (Madagascar and the Great Comores) presented here being the first of the series. The last part will provide a survey of the entire genus.

The cultivation of waterplants I find essential for their proper understanding, especially when one is able to try them out under various conditions. This enables one to get a better insight in their plasticity towards the environment, which in turn gives some measure for evaluating the importance of certain vegetative characters. Their amplitude of phenetic variation is sometimes so large that extremes may look very different. Furthermore, one can study at leisure details of flower, fruit, seed, and embryo in cultivated plants.

Of the eleven species distinguished I was able to cultivate four, viz. *A. boivianus*, *A. decaryi*, *A. madagascariensis*, and *A. ulvaceus*. Just before this paper was going into print I received living corms of *A. bernierianus* and *A. dioecus*.

Of all species a geographical map of their Malagasy distribution has been compiled. The localisation of the records was not always easy. Some place names occur more

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Distribution maps of Malagasian species of *Aponogeton*.

than once in Madagascar; in such cases the one was chosen which best fitted the pattern of distribution. For example, 'Ambatolampy' occurs in the Gazetteer about thirty times. Some place names could not be found at all in the spelling given on the labels; these could sometimes be traced by means of the phonetic translation of Malagasian words. For example, Be Nilus Mountains on a sheet of J. T. Last (K). Assumedly this is Be Kilus which would be the phonetic translation of Bekolosy. The Bekolosy is a massif in the Sambirano area. This, added to the fact that Last collected material of the same species in 'mountains at source of Sambirano river' (BM) in the same period, makes it almost certain that the first-mentioned sheet came from the same area.

All species treated here seem to be endemic in Madagascar; one or possibly two, occur also on the Great Comores. *A. madagascariensis* occurs introduced and to some extent naturalized in Mauritius.

Acknowledgments. As already mentioned above I am very much obliged to several persons, especially to Mr R. Capuron at Tananarive and Mr J. Bogner at Augsburg, who generously provided me with living material of several species not cultivated before. Sincere thanks are due to Mr J. Bosser and Dr H. Heine, both of the Muséum d'Histoire Naturelle at Paris. The former gave most welcome assistance for the drawing of the distribution maps by localizing place names which could not be found in the Gazetteer. Dr Heine was very helpful by making a thorough investigation of the intricate bibliography of *A. madagascariensis*. Furthermore I have to tender my thanks to the directors and the staff of the following herbaria which I could either visit or who allowed me to borrow specimens, viz. the British Museum, Natural History, Bot. Department (BM), The Royal Botanic Gardens, Kew (K), the Rijksherbarium, Leyden (L), and the Muséum d'Histoire Naturelle, Phanérogamie, Paris (P). Furthermore, I am indebted to Prof. Dr C. G. G. J. van Steenis. He allowed Miss R. van Crevel to make the drawings and stimulated my work. His advices in framing this paper are very much appreciated. Finally, sincere thanks are due to Dr R. C. Bakhuizen van den Brink Jr who prepared the Latin diagnoses of the new species.

APONOGETON

Linné *f.*, Suppl. (1781) 32; Planchon, Ann. Sc. Nat. 3e sér. 1 (1844) 107; Edgew., in Hook. Lond. Journ. 3 (1844) 402; Hook. *f.*, in Benth. et Hook., Gen. Pl. 3 (1883) 1014; Engler, in Engler et Prantl, Nat. Pfl. Fam. 2, 1 (1889) 218; Engler et Krause, Pfl. R. Heft 24 (1906). — *Amogeton* Neck., Elem. 3 (1790) 276, *nom. inval.*, also a new name for *Aponogeton* L. *f.* — *Uvirandra* Mirbel, Hist. Nat. Gén. Part. Pl. 4 (year 11 of the French revolutionary calender = Sept. 1802—Sept. 1803) 117 = part 41 of Buffon, Hist. Nat., ed. Sonnini; St. Hil., Expos. 1 (1805) 52; Thouars, Gen. Nov. Madag. (1806) 2, 'Ouvirandra'. — *Aponogeton* Schrad. ex Steud., Nom. ed. 2, 1 (1840) 114, *nomen in synonym.* — *Spathium* (*non* Lour.) Edgew., Journ. As. Soc. Beng. 11 (1842) 145. — *Limnogeton* Edgew. ex Lindl., Veg. Kingd. ed. 2 (1847) 210, *nomen (non vidi)*.

Perennial waterplants with a tuberous or elongate and often branching rootstock or rhizome which produces the tuft of submerged or floating leaves and the inflorescences. *Leaves* with a mostly distinct midrib and one or more pairs of parallel main nerves connected by numerous cross veins. *Inflorescences* on long peduncles, emerging above the water surface, in bud enveloped by a caducous or rarely persistent spathe, composed of one solitary or 2—10 spikes. Plants rarely dioecious, very seldom apogamous; flowers in most species bisexual, mostly spirally arranged on the rachis, more rarely dorsiventrally set. *Tepals* (0—1) 2 (—6), mostly persistent, rarely caducous, in the Malagasian species

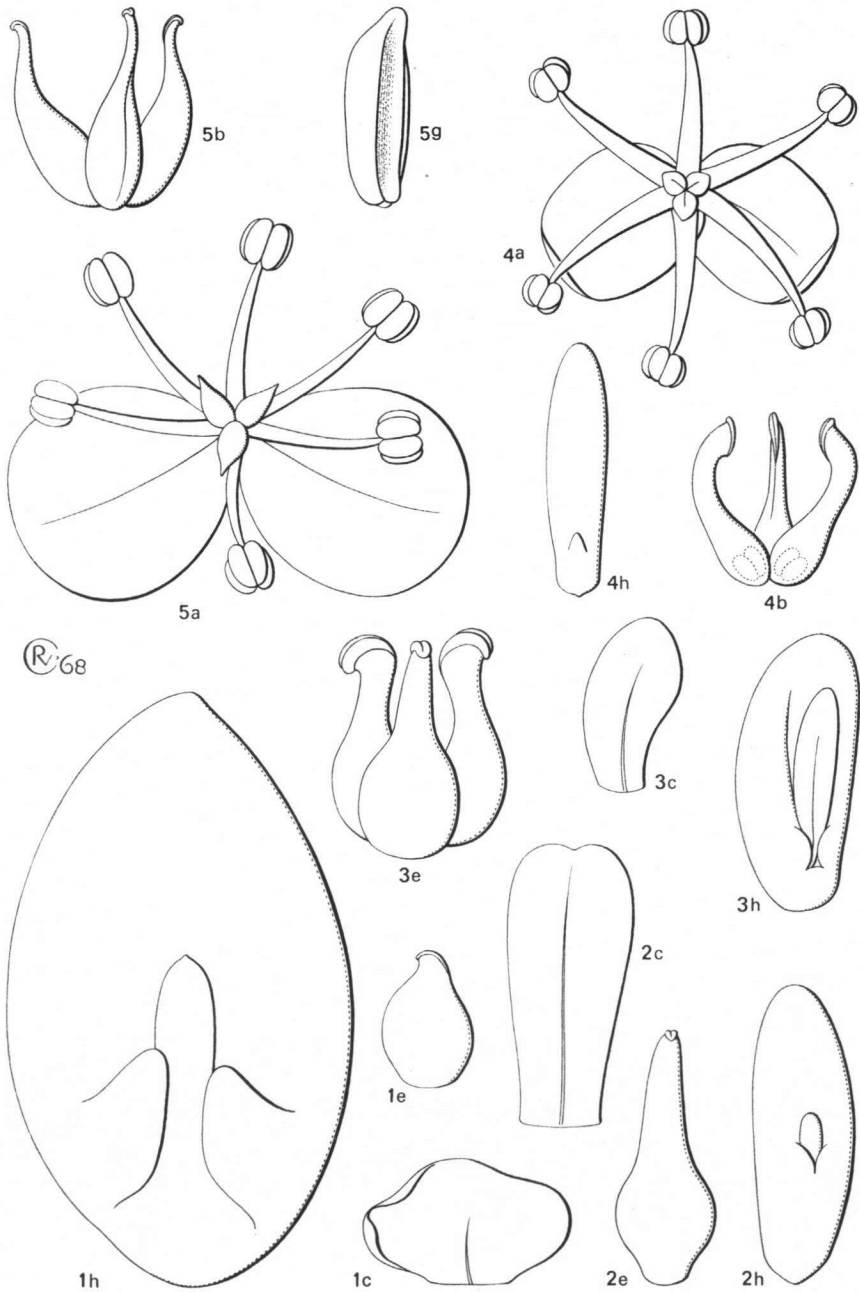


Fig. 1. 1. *A. bernierianus* (Decne) Hook. f. — 2. *A. boivinianus* Baill. ex Jum. — 3. *A. madagascariensis* (Mirb.) Bruggen. — 4. *A. decaryi* Jum. — 5. *A. dioecus* Bosser. All $\times 14$.

The letters behind the figures indicate: a. ♂ flower, b. ♀ flower, c. tepal, e. ovary or gynoeceium, g. seed, h. embryo.

mostly 2 and always persistent. *Stamens* in 2 or more whorls, 6 or more, rarely less. *Carpels* (2—) 3 (—9), free, mostly sessile, narrowed into the style with a stigmatic ridge on the inner side; ovules 1—8 per carpel. *Carpels in fruit* with a mostly distinct, lateral or terminal, often curved beak. *Seeds* without endosperm; testa mostly consisting of a single envelope, sometimes, however, split into two envelopes, an inner one closely fitting the embryo and a loose, transparent outer one. *Embryo* with the plumule fitting in a groove or not, or without a plumule.

Ecology: Some species of Madagascar have a fairly wide ecological tolerance, being found from the plains to the mountains, both in running and stagnant water. Other species can only be found in fast running streams and torrents; others again only in stagnant water in marshes. One species (perhaps more) is confined to habitats which are wet only in a short season but desiccated during the greater part of the year. On the whole the species of *Aponogeton* only grow in widely scattered batches. They can often be traced with the help of the natives who eat the tubers boiled or roasted and who know the plants as *Ovirandra*, *Ovirandrana*, *Tsikapetaka*, *Tsiambaravaly*, *Dorodoro*, *Rondrabe*, *Gijo* or *Gizo*, depending on the tribe.

Fruit setting is fairly abundant and sometimes occurs very soon after pollination, which is through the air. Self-fertilisation may for instance occur if spikes become submerged for a moment. Spathes of *A. madagascariensis* which for one reason or another do not reach the surface, remain closed but fruits are nevertheless produced. Whether insects play a role in the pollination of bisexual or dioecious species is still unknown. After pollination the young infructescence submerges. At maturity the pericarp decays and the seeds get off. When the testa is simple, the seeds will float on the surface of the water as the envelope consists of floating tissue. After a very short time, a few hours, the testa will decay too and the embryo sinks to the bottom. When the testa is double the seed has no floating power and sinks to the bottom at once. Germination will then take place after a resting-period of one day to several weeks.

KEY TO THE SPECIES

based on gross morphology

- | | |
|--|-------------------------------|
| 1. Leaves fenestrate | 1. <i>A. madagascariensis</i> |
| 1. Leaves not fenestrate. | |
| 2. Leaves subulate, without proper blade | 2. <i>A. dioecus</i> |
| 2. Leaves with petiole and distinct blade. | |
| 3. Leaf-blade less than ± 7 cm long and up to 3 times as long as wide. | |
| 4. Inflorescence with 2 spikes, dioecious | 3. <i>A. decaryi</i> |
| 4. Inflorescence with 1 spike, bisexual | 4. <i>A. tenuispicatus</i> |
| 3. Leaf-blade longer than ± 7 cm. | |
| 5. Leaf-blades bullate. | |
| 6. Inflorescence with 2 spikes | 5. <i>A. boivinianus</i> |
| 6. Inflorescence with 3 or more spikes | 6. <i>A. bernierianus</i> |
| 5. Leaf-blades not bullate; flat, undulate, or spiralized. | |
| 7. Leaves less than 3 times as long as wide. Inflorescence with 2 spikes, dorsiventral. | 7. <i>A. cordatus</i> |
| 7. Leaves more than 3 times as long as wide. | |
| 8. Leaves up to $\pm 1\frac{1}{2}$ cm wide. | |
| 9. Inflorescence robust, densely flowered. Flowers violet to rose. | 8. <i>A. longiplumulosus</i> |
| 9. Inflorescence smallish, sparsely-flowered. Flowers white | 9. <i>A. viridis</i> |
| 8. Leaves more than ± 2 cm wide. | |
| 10. Leaves mostly brownish or blackish-green, flat or strongly undulate. Tepals of various shape, \pm as long as wide. Testa simple and embryo with plumule. | 10. <i>A. capuronii</i> |

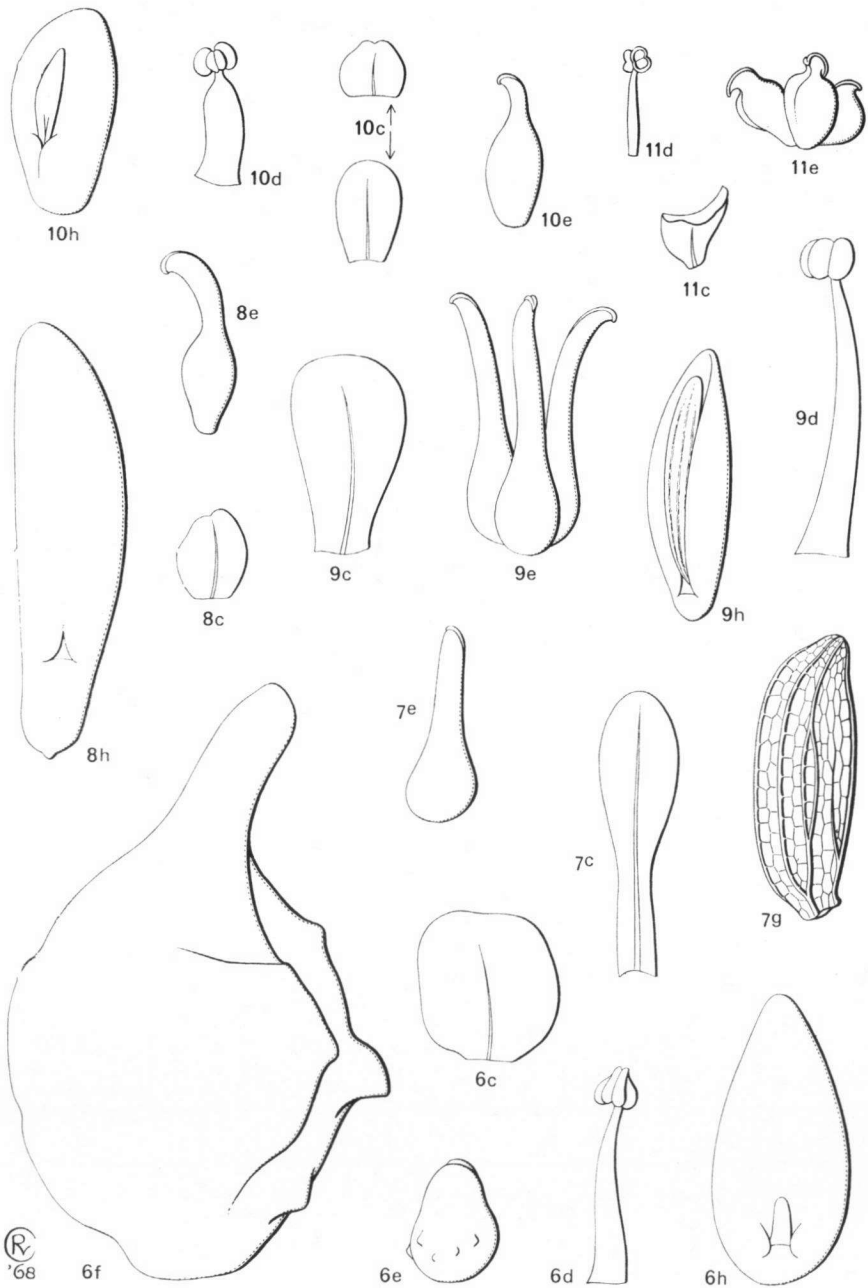


Fig. 2. 6. *A. capuronii* Bruggen. — 7. *A. ulvaceus* Baker. — 8. *A. cordatus* Jum. — 9. *A. longiplumulosus* Bruggen. — 10. *A. viridis* Jum. — 11. *A. tenuispicatus* Bruggen. All $\times 14$.

The letters behind the figures indicate: c. tepal, d. stamen, e. ovary or gynoecium, f. fruit, g. seed, h. embryo.

10. Leaves mostly bright-green, flat or undulate. Tepals narrowly obovate and often clawed, more than twice as long as wide. Seed with a double testa and embryo without plumule **II. A. ulvaceus**

KEY TO THE SPECIES

based on the structure of seed and embryo *)

1. Seed-coat distinctly consisting of two envelopes; the loose outer one transparent, the inner brown and fitting the shape of the embryo.
 2. Outer seed-coat distinctly reticulately veined. Leaves with broad blade . . . **II. A. ulvaceus**
 2. Outer seed-coat not reticulate. Leaves subulate **2. A. dioecus**
1. Seed-coat simple.
 3. Embryo longer than 4 mm.
 4. Embryo about twice as long as thick **6. A. bernierianus**
 4. Embryo about 4—5 times as long as thick **7. A. cordatus**
3. Embryo shorter than 4 mm.
 5. Plumule absent. **3. A. decaryi**
 5. Plumule present.
 6. Plumule longer than ± 1 mm.
 7. Plumule without veins or other markings **9. A. viridis**
 7. Plumule with a distinct midrib.
 8. Plumule very long, \pm reaching the apex of the embryo; mostly three-ribbed.
 8. A. longiplumulosus
 8. Plumule distinctly not reaching the apex of the embryo, one-ribbed.
 1. A. madagascariensis
6. Plumule shorter than 1 mm.
 9. Plumule not fitting in a groove **5. A. boivinianus**
 9. Plumule fitting in a groove of the embryo. **10. A. capuronii**

I. *Aponogeton madagascariensis* (Mirbel) van Bruggen, *comb. nov.* — *Uvirandra madagascariensis* Mirbel, Hist. Nat. Gén. Part. Pl. 7 (year 11 of the French revolutionary calendar: Sept. 1802—Sept. 1803) = part 48 of Buffon, Hist. Nat., ed. Sonnini, 452. — Type: *du Petit-Thouars s.n.* (P). — Fig. 1: 3; map 1.

Hydrogeton fenestralis Pers., Syn. Pl. 1 (1805) 400. — *Ouvirandra fenestralis* Poir. in Lamk, Enc. Méth. Bot. Suppl. 4 (1816) 237. — *A. fenestralis* Hook. f., in Benth. et Hook., Gen. Pl. 3 (1883) 1014; Engler et Krause, Pfl. R. Heft 24 (1906) 18, fig. 7; Jumelle, Fl. Madag. 23 (1936) 2, fig. 1. — Type: *du Petit-Thouars s.n.* (P).

A. fenestralis var. *major* Baum, Gartenwelt 10 (1906) 594, fig. — Type: unknown to exist.

A. henkelianus Baum, Gartenwelt 10 (1906) 593, 4 fig. — *A. fenestralis* var. *henkelianus* Falkenb. et Baum, ex Baum, Taschenkalender Aq.-Terr. Fr. (1938) 127. — Type: unknown to exist.

A. guillotii Hochr., Ann. Cons. Jard. Bot. Genève 10 (1907) 47, fig. 1. — *A. fenestralis* var. *guillotii* Jumelle, Fl. Madag. 23 (1936) 2, fig. 1 2. — Type: *Guillot 5* (K).

Ouvirandra bernieriana (non Decaisne) Hook., Bot. Mag. (1858) t. 5076, *pro descr. et icon.* — *A. bernieriana* [non (Decaisne) Hook. f.] Hook. f., in Benth. et Hook., Gen. Pl. 3 (1883) 1014, *quoad sched.*; Engler et Krause, Pfl. R. Heft 24 (1906) 17, ditto.

Tuber elongate, ovate or globular, up to 3 cm \varnothing . *Leaves* submerged, leaf-blade fenestrate, very variable in shape, size, and fenestration, oval, oblong, lanceolate, ovate or obovate, up to 55 by 16 cm (for example 20 \times 2 $\frac{1}{2}$ cm, 23 \times 10 cm, 32 \times 5 $\frac{1}{2}$ cm, 53 \times 9 cm);

*) I am not quite certain that I have had in all cases fully ripe fruits and hence fully mature embryos of the species which I only know from the herbarium. A careful checking of this key will therefore be desirable. Fruit and embryo of *A. tenuispicatus* are unknown.

base cuneate, rounded, or slightly cordate, often inaequilateral; apex cuneate, rounded, truncate, or emarginate and often acuminate. Midrib wide with 3—10 parallel nerves on either side, connected by numerous transverse veinlets; the mesophyll is lacking between the nerves either completely — the leaf being reduced to the nerves and having rectangular openings—or partly—the openings being small and rounded; some leaves may even not be fenestrate; petiole 3—35 cm. *Peduncle* up to 1.3 m, gradually thickening towards the inflorescence (up to $1\frac{1}{2}$ cm \varnothing); spathe up to $2\frac{1}{2}$ cm with an acumen of up to 2 cm, caducous; inflorescence with 2—4 (—6) spikes of up to 9 (—20) cm, rather densely flowered. *Flowers* turned towards all directions. Tepals 2 or 3, ovate or obovate, up to 2 by $\frac{1}{2}$ —1 mm, white or violet, 1 (or 3)-ribbed. Stamens 6, 2—3 mm, filaments not or hardly widened towards the base. Ovaries 3—6, 2— $2\frac{1}{2}$ by $\frac{3}{4}$ —1 mm; ovules 2 or 4. *Inflorescence* up to 20 cm. *Fruits* up to $8\frac{1}{2}$ by 5 mm. *Seeds* \pm $3\frac{1}{2}$ by $1\frac{1}{4}$ mm; testa single, sometimes purple; plumule attached near the base of the embryo and fitted in a wide groove.

Distribution: Central, West and East Madagascar, Great Comores (not seen); naturalized in Mauritius.

Ecology: In stagnant or running waters, also in rapids and torrents, on basalt but also on calcareous rocks and in marshes, often in forests, between sea-level and 1800 m altitude; apparently flowering throughout the year.

Notes. The well-known lace-plant, which during more than one hundred years has been cultivated increasingly by horticulturists, aquarists etc. has in several hundreds of publications always been mentioned as *A. fenestralis*. Unfortunately the name has to be changed in *A. madagascariensis* as *Uvirandra madagascariensis* was described 2 or 3 years before *Hydrogeton fenestralis*. The date of publication has been checked thoroughly. The 'Journal général de la littérature française' 6 (Brumaire an XII de la République française: 24.X—22.XI.1803) 221, announces the publication of the parts 6 and 7 of the work in question. This proves that *Uvirandra madagascariensis* has been described before 24th Oktober 1803.

A. madagascariensis is a very variable species and so it happened that botanists cultivating two quite different forms, described new varieties or even species, based on differences in fenestration and tuber. There is, however, so much variation in the degree of these characteristics and there are so many intermediate forms, that the extremes do not deserve a special specific or varietal rank. One of these 'species' is *A. henkelianus* described because of the irregular fenestration of the leaves. No type material is preserved at the Berlin and Rostock herbaria. As far as I know this name was for the first time validly published by Baum in 1906. However, Baum himself cited it later in 'Taschenkalender für Aquarien- und Terrarienfrenunde' 1938, p. 127 under the name *A. fenestralis* var. *henkelianus* Falkenb. et Baum; I have not traced an earlier publication of this varietal combination.

A. guillotii was distinguished because of the small, rounded openings in the leaves.

A. madagascariensis is commonly introduced in Europe by aquarists. Unfortunately the plants are difficult to keep alive and mostly die within half a year. If the plants flower during that short period the peduncles are often too short to reach the water surface. It is remarkable that self-pollination obviously takes place in bud and that fruit is set under these conditions.

As a result of the large-scale trade in this plant, due to its difficult cultivation, it seems that many localities in Madagascar have been stripped of this magnificent species. Measures should be taken to prevent its extinction.

2. *Aponogeton dioecus* J. Bosser, *Adansonia* 6 (1966) 156, fig. 2. — Type: J. Bosser 10908 (P). — Fig. 1: 5; map 2.

Tuber globular or ovate, small, 5–13 mm \varnothing . *Leaves* submerged, bright green, subulate, half-terete, 20–25 cm by $1\frac{1}{2}$ –2 mm, gradually narrowing towards the blunt apex; parallel main nerves 5, indistinct. *Peduncle* very slender, up to 55 cm, gradually thickening until 1 mm \varnothing under the inflorescence. *Spathe* $1\frac{1}{2}$ cm, acuminate, pale green, caducous; inflorescence with one spike. *Flowers* turned towards all directions. σ Inflorescence 5–6 cm, laxly flowered. *Tepals* 2, orbicular, greenish-yellow 2– $2\frac{1}{2}$ by 2 mm, 1-ribbed, rarely with 2 or 3 nerves. *Stamens* 6, 2– $2\frac{1}{2}$ mm; filaments not or hardly widening towards the base; anthers olivegreen or yellow. *Ovaries* 3, rudimentary and sterile. φ Inflorescence densely flowered, 1– $1\frac{1}{2}$ cm. *Tepals* and *stamens* absent. *Ovaries* 3, up to $2\frac{1}{2}$ by $\frac{3}{4}$ mm; *ovules* 2. *Infructescence* 2– $2\frac{1}{2}$ cm. *Fruit* $3\frac{1}{2}$ – $4\frac{1}{2}$ by $1\frac{1}{2}$ mm, terminally beaked. *Seeds* 2 by $\frac{3}{4}$ mm, testa double; the outer envelope loose, membranaceous and transparent, the inner one brown and closely fitting the embryo; embryo $1\frac{1}{2}$ by $\frac{1}{2}$ mm, plumule absent.

Distribution: Ankaratra-Mountains: near Mandritsara.

Ecology: Shallow pools (25–50 cm), exposed to the sun, at 2000 m altitude with stagnant and acid water. The tubers are rooted in mud at about 1–2 cm below the surface of the soil. The plants are growing together with some *Cyperaceae*, *Lagarosiphon madagascariense*, and *Ottelia ulvaeifolia*. In March 1968 the temperature of the water was 23° C, the total hardness 0.56° DH, and the conductivity 30.97 microsiemens/cm by 20° C (partly Bogner in litt.). At least flowering in February and March.

Note. Mr Bosser was able to observe two big populations; he found that the ratio between σ and φ specimens was at least ten to one. This agrees with the likewise dioecious *A. decaryi*.

3. *Aponogeton decaryi* Jumelle, [Fl. Madag. 23 (1936) 10, fig. III 2, *descr. gall.*] Not. Syst. 11 (1943) 1, *descr. lat.* — Type: Decary 9400 (P). — Fig. 1: 4; pl. I, II left; map 2.

Tuber small, 5–15 mm \varnothing , globular or ovate. *Leaves* floating, linear, oblong, ovate, or obovate, 4–7 by $1\frac{1}{2}$ – $3\frac{1}{2}$ cm (σ) or $1\frac{1}{2}$ –4 by 1– $2\frac{1}{2}$ cm (φ); base broadly cuneate, rounded, or subcordate, apex broadly cuneate, rounded, or truncate and mostly shortly acuminate; midrib wide with 2 or 3 parallel nerves on either side; upper side green, lower side pale green; petiole 10–30 cm, depending on the water-depth. *Peduncle* very slender, 10–30 cm, near the base $\frac{1}{2}$ mm \varnothing and under the inflorescence 1 mm \varnothing . *Spathe* cone-shaped, caducous, 1 cm by 4 mm (σ) or 7 by 2 mm (φ); inflorescences with 2 spikes, laxly flowered and fragrant. *Flowers* turned towards all directions. σ Inflorescence up to 9 cm. *Tepals* 2, white, ovate, obovate, or nearly orbicular, up to 2 by $1\frac{3}{4}$ mm, 1-ribbed. *Stamens* 6, 2 mm; filaments slightly thickening towards the base; anthers greenish yellow, pollen yellow. *Ovaries* 3, rudimentary and sterile. φ Inflorescence up to $3\frac{1}{2}$ cm. *Tepals* and *stamens* absent. *Ovaries* 3 (rarely 2), up to $2\frac{1}{2}$ by $\frac{1}{2}$ mm; *ovules* 2. *Infructescence* up to 6 cm. *Fruit* up to 6 by $1\frac{3}{4}$ mm, terminally beaked. *Seeds* \pm 3 by $\frac{3}{4}$ mm, testa simple; embryo without plumule (only a thickening indicates the place where afterwards the first leaf will develop).

Distribution: SE., S. Central and Central Madagascar.

Ecology: Temporary, shallow waters at 0–650 m altitude, sometimes formed in rivers, which are running dry and remain without water for the greater part of the year.

Note. Mr Capuron has sent me about 45 living corms of this rare species collected in a little pool between Amboasary and Bevilany. The plants, received on Nov. 23rd, 1967, showed an astonishing growing capacity. On Dec. 4th they had already developed

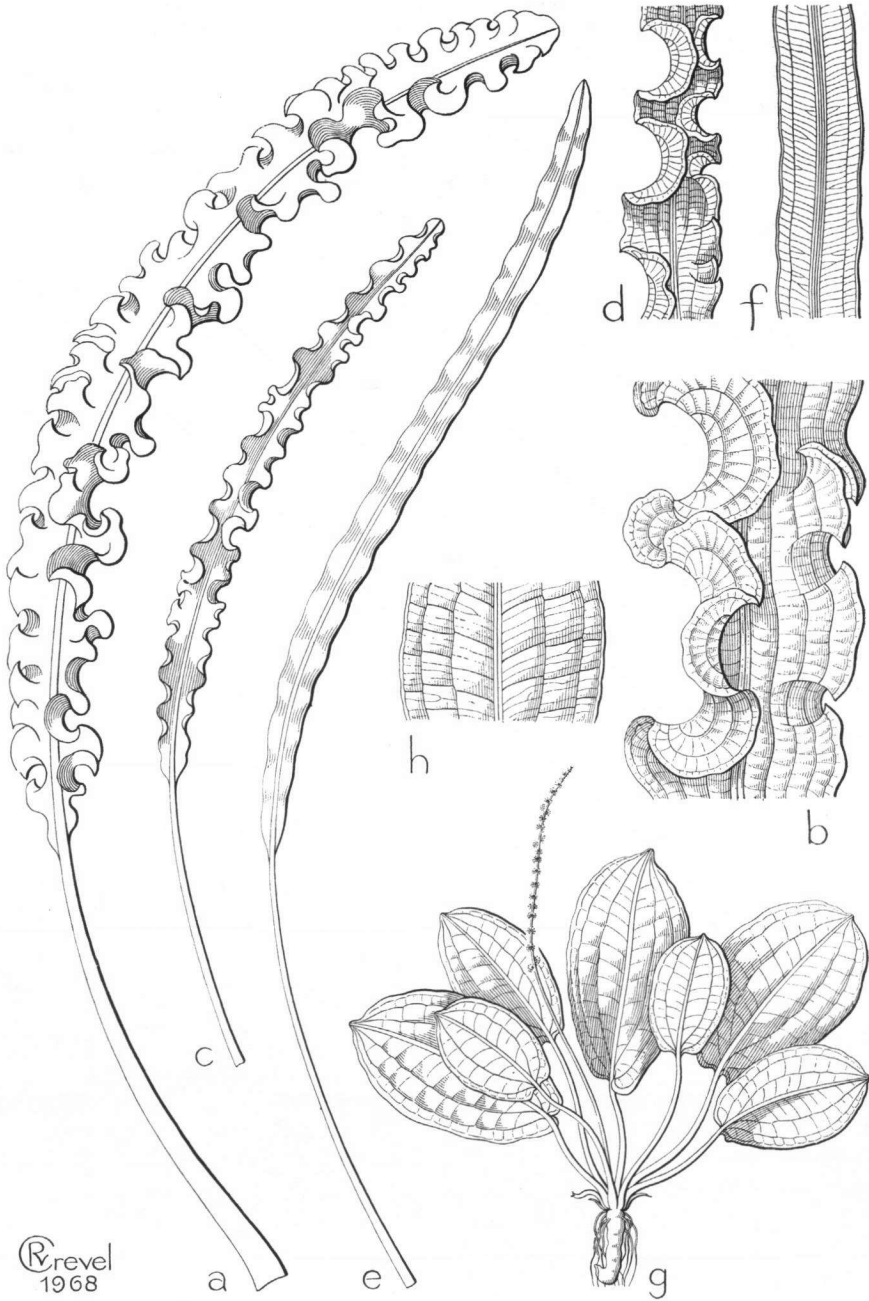


Fig. 3. a. *A. capuronii* Bruggen, leaf, $\times \frac{1}{2}$, b. the same, leaf detail, nat. size. — *A. longiplumulosus* Bruggen, c. leaf $\times \frac{1}{2}$, d. the same, leaf detail, nat. size, e. leaf, $\times \frac{1}{2}$, f. the same, leaf detail, nat. size. — *A. tenuispicatus* Bruggen, g. habit, $\times \frac{1}{2}$, h. the same, leaf detail, nat. size. (a—b Decary 101 01, c—d Decary 2154, e—f Last s.n. in K, g—h Rakotozafy 544).

28 inflorescences and many floating leaves. On Dec. 10th the first seeds were ripe. It was remarkable that among the 45 plants there were only 5 ♀ plants. This agrees with *A. dioecus*, where J. Bosser found that the ratio between ♂ and ♀ plants was ten to one.

4. *Aponogeton tenuispicatus* van Bruggen, *sp. nov.* — Type: Antanandavahely, A. Rakotozafy 544, 20-7-1966 (P). — Fig. 2: **II; **3 g, h**; **map 2**.**

Tuber elongatum, c. 5 mm Ø. *Folia* omnia submersa, ovalia vel obovata, 4-7 cm longa, 2-4 cm lata, basi truncata vel cordata, apice rotundata, apiculata; costa in utroque latere nervis parallelis 3 comitata; petiolus 4-6 cm longus. *Pedunculus* ad 10 cm longus, gracilis, inflorescentiam versus haud incrassatus. Spatha c. 8 mm longa, caduca; inflorescentia 1-spicata, spica ad 5 cm longa, tenuis, laxiflora. *Flores* minutissimi, omnifarii. Tepala 2, cuneiformis, c. $\frac{3}{4}$ mm longa ac lata, alba. Stamina 6, $1\frac{1}{4}$ - $1\frac{1}{2}$ mm, filamentis basin versus subdilatatis. Ovaria (2-3)(-4), c. $1 \times \frac{1}{2}$ mm; ovula 2. *Fructus et semina* ignoti.

Tuber elongate, \pm 5 mm Ø. *Leaves* all submerged, oval or obovate, 4-7 by 2-4 cm, flat; base truncate or cordate, apex rounded and apiculate; 3 parallel nerves on either side of the midrib; petiole 4-6 cm. *Peduncle* up to 10 cm, very slender, not thickened towards the inflorescence. Spathe \pm 8 mm, caducous; inflorescence with 1 spike of up to 5 cm, laxly flowered, slender. *Flowers* very small, turned towards all directions. Tepals 2, wedge-shaped, \pm $\frac{3}{4}$ by $\frac{3}{4}$ mm, white. Stamens 6, $1\frac{1}{4}$ - $1\frac{1}{2}$ mm, filaments slightly widening towards the base. Ovaries (2-3)(-4), \pm 1 by $\frac{1}{2}$ mm; ovules 2. *Fruit and seed* unknown.

Distribution: District Antalaha, canton Ambohitralanana: River Onive near Antanandavahely.

Ecology: Marsh between two mountains in a forest; flowered in July.

Note. As far as I know this is the first *Aponogeton* having been found in this little known part of Madagascar.

5. *Aponogeton boivinianus* Baillon *ex* Jumelle, Ann. Mus. Colon. Mars., [III, IV-2 (1916) 27, *nomen*] X-1 (1922) 9; Fl. Madag. 23 (1936) 8, fig. III 1, *pro parte*. — Type: Perville 420, (P, 3 sheets, one indicated type, the others isotype). — Fig. 1: **2; **4**; **pl. II right**; **map 2**.**

Tuber large, globular or disk-shaped, up to 3 cm Ø. *Leaves* submerged; leaf-blade dark-green, strongly bullate and firm, 6-30 by $1\frac{1}{2}$ -5(-8) cm; base rounded or shortly attenuate, apex narrowly cuneate with a blunt or retuse tip; midrib wide, 3 or 4 parallel nerves on either side; petiole ($1\frac{1}{2}$ -)6-13 cm. *Peduncle* up to 55 cm, near the base 3 mm Ø, gradually thickening towards the inflorescence until 7-10 mm Ø. Spathe up to 2 cm with a long acumen ($1\frac{1}{2}$ -2 $\frac{1}{2}$ cm), caducous; inflorescence with 2, very rarely 3 spikes, rather densely, sometimes laxly flowered, spikes up to 20 cm, scentless. *Flowers* turned towards all directions. Tepals 2, \pm 2 $\frac{3}{4}$ by $1\frac{1}{4}$ mm, narrowly obovate, sometimes spatulate, white or (seldom) pink, 1-ribbed. Stamens 6, \pm 3 mm; filaments only slightly broadening, towards the base; anthers cream, pollen yellow. Carpels 3(4), 2 $\frac{1}{2}$ by 1 mm; ovules (3-6)(-7). *Fruits* with a distinct terminal beak, 8 by 4 mm, reddish brown. *Seeds* \pm 3 by 1 mm, testa simple; embryo with a short, blunt plumule, attached at one third of the height of the embryo and not fitted in a groove.

Distribution: N. Madagascar, Prov. Diégo-Suarez; Nossi-Bé; Mayotte.

Ecology: Rapids and slow or fast running streams and rivers on igneous rock, such as basalt and lava, both in deep and in shallow water and in sunny and shadowed positions; between 50 and 500 m altitude (partly Capuron in litt.). Flowering time September-February.

Note. Mr R. Capuron has sent me some living corms of this species, collected in the river Mamendo (Ambre Mountains). The colour-photograph inserted here has been made of one of these plants, cultivated by me.

6. *Aponogeton bernierianus* (Decaisne) Hook. f., in Benth. et Hook., Gen. Pl. 3 (1883) 1014, *pro nomen*; Engler et Krause, Pfl. R. Heft 24 (1906) 17, *pro nomen*; Jumelle, Fl. Madag. 23 (1936) 6, fig. II 2. — *Ouvirandra bernieriana* Decaisne, in Delessert, Icon. Select. Pl. 3 (1837) t. 100; Hook., Bot. Mag. (1858) t. 5076, *pro nomen, excl. descr. et tab.* — Type: *Bernier s.n.* (P). — **Fig. 1: 1; map 2.**

A. quadrangulare Baker, Journ. Linn. Soc. 18 (1881) 279; Engler et Krause, Pfl. R. Heft 24 (1906) 16; Jumelle, Fl. Madag. 23 (1936) 8, fig. II 1. — Type: *Langley Kitching s.n.* (K).

Tuber large, oblong or ovate, or elongate and branching, up to 4 cm \varnothing ; roots very strong, up to 5 mm \varnothing . *Leaves* submerged; leaf-blade very variable, 11–50(–120) by $1\frac{1}{2}$ – $6\frac{1}{2}$ (–10) cm, mostly strongly bullate, sometimes undulate, darkgreen or reddish-brown; base cuneate, rounded, or cordate; apex broadly or narrowly cuneate with a blunt or acute tip; midrib wide with 2–4 parallel nerves on either side; petiole 3–13 cm. *Peduncle* up to 75 cm long and 2 cm \varnothing , tapering towards the inflorescence. *Spathe* \pm 15 mm, caducous; inflorescence with 3–10 spikes of up to 8 cm, densely flowered. *Flowers* turned towards all directions. *Tepals* 2, rarely 3, white, broadly obovate, angular, \pm $1\frac{1}{2}$ by $1\frac{1}{2}$ –2 mm, 1-ribbed. *Stamens* 6, $1\frac{3}{4}$ –2 mm; filaments slightly widening towards the base. *Ovaries* 3(4), $\frac{3}{4}$ – $1\frac{3}{4}$ by $\frac{1}{2}$ –1 mm; *ovules* 2. *Fruits* \pm 10 by 7 mm with a short terminal beak. *Seeds* \pm 7 by 4 mm, testa single; plumule attached near the base of the embryo and fitted in a narrow groove, partly covered by two appendages of the cotyledon.

Distribution: E. Madagascar, from Sainte-Marie until the river Matitanana.

Ecology: In some places very common in slow or fast running streams and rapids in forests and marshes up to 1200 m altitude, both in sunny and shaded positions. The corms are eaten boiled or roasted and are said to taste like hazelnuts. Mr Bogner collected the species in the river Varaina (Reserve Zahamena). The tubers were rooted between stones in gravel at a depth of about 5–8 cm below the surface of the soil, on gneiss. The fast running water was acid, clear, and dark-coloured (perhaps by humic acid); the total hardness was 1.06° DH and the conductivity 31.15 microsiemens/cm by 20° C. The plants were growing together with two species of *Hydrostachys*.

Obviously flowering throughout the year.

Notes. In 1858 W. J. Hooker wrongly made a description of *Ouvirandra bernieriana* from a cultivated specimen of *A. madagascariensis* with small, rounded openings in the leaf. Afterwards almost all descriptions of *A. bernierianus* or *O. bernieriana* referred to about similar forms of *A. madagascariensis*. Also Hooker f., in 1883 on transferring *Ouvirandra bernieriana* to *Aponogeton*, apparently had this form in mind.

A. madagascariensis can at once be distinguished from *A. bernierianus* by its fenestrate leaves and it is curious that they were confused by Hooker and most subsequent authors.

7. *Aponogeton cordatus* Jumelle, Ann. Mus. Colon. Mars. [III, IV–2 (1916) 28, *nomen*] X–I (1922) 13; Fl. Madag. 23 (1936) 13, fig. IV 2, *pro parte.* — Type: *Perrier de la Bâthie 7160* (P, 2 sheets, one indicated type, the other isotype). — **Fig. 2: 8; map 3.**

Tuber probably very small, less than 1 cm \varnothing . *Leaves* presumably submerged, oval, membranaceous and transparent, 8–17 by 4–9 cm; base cordate, apex rounded and sometimes emarginate; 3–4 parallel nerves on either side of the midrib; petiole 6–20 cm. *Peduncle* up to 30 cm, slender, only slightly thickening towards the inflorescence. *Spathe*



Fig. 4. *A. boivinianus* Bail. ex Jum. Cultivated specimen, with developing inflorescence.

1½ cm by 2 mm, caducous; inflorescence with 2 spikes, laxly flowered, dorsiventral, spikes up to 3 cm. Tepals 2, ovate or obovate, up to 1 mm long and wide, white, 1-ribbed. Stamens (4–5)—6, 1½–1¾ mm, filaments thickening towards the base. Ovaries 3, 1½–2 by ½–¾ mm, with a curved tip; ovules 2. *Infructescence* 10 cm. *Fruit* nearly 1 cm by 2½ mm with a terminal beak. *Seeds* up to 6 by 1¼ mm, testa simple; embryo with a very small groove at about ¼ of the height, without plumule (seeds unripe?).

Distribution: Analamazoatra.

Ecology: Found in a marsh in a forest at 800 m alt. Flowered in February.

Note. *A. cordatus* is apparently a very rare and moreover insufficiently known species which has been collected only once in February 1912. The description has been made from this collection and might be not quite complete for lack of sufficiently mature material. A re-collection of this species and, if possible, cultivation of it would be very desirable. The original locality at Analamazoatra, however, might be lost. Mr Bogner looked thoroughly for the species there in February 1968, but in spite of the wet season, he could not even find any marsh.

8. *Aponogeton longiplumulosus* van Bruggen, *sp. nov.* — Type: District of Maromandia, valley of the Antsahakolany, 10-6-1923, *Decary 2154* (P). — **Fig. 2: 9; 3c-f; map 3.**

Tuber globosum, usque ad 2 cm Ø. *Folia* breviter (usque ad 12 cm) petiolata, valde probabiliter submersa; laminae 20–35 cm longae, usque ad 1½ cm latae, saepe valde undulatae, basi cuneatae, apice anguste cuneatae, obtusae vel acutae; costa lata, in utroque latere nervis parallelis 1–3 comitata. *Pedunculus* 50–150 cm longus, inflorescentiam versus valde incrassatus; spatha c. 2 cm (acumine c. 5 mm longo incluso), plerumque caduca; inflorescentia bispicata, spicis usque ad 10 cm longis, densiflora. *Flores* omnifarii. *Tepala* 2, ovalia ad obovata, 2–2½ mm longa, 1 mm lata, rosea ad lilacina. *Stamina* 6, usque ad 3 mm longa, filamentis basin versus subdilatis. *Ovaria* 3, c. 3 mm longa, 1 mm crassa, ovulis 2. *Fructus* usque ad 4 mm longi, 1½ mm lati. *Semina* usque ad 3 mm × 1 mm, testa una; plumula striata, embryonis aequilonga, ad basin embryonis inserta atque in sulco apta.

Tuber globular, up to 2 cm Ø. *Leaves* shortly (up to 12 cm) petiolate, most probably submerged; leaf blades 20–35 by up to 1½ cm, often strongly undulate; base narrowly cuneate, apex narrowly cuneate, blunt or acute; midrib wide, 1–3 parallel nerves on either side. *Peduncle* 50–150 cm, strongly thickened towards the inflorescence; spathe ± 2 cm (inclusive an acumen of about 5 mm), mostly caducous; inflorescence with 2 spikes, spikes up to 10 cm, densely flowered. *Flowers* turned towards all directions. *Tepals* 2, oval or obovate, 2–2½ by 1 mm, pink-violet. *Stamens* 6, up to 3 mm, filaments slightly widened towards the base. *Ovaries* 3, ± 3 by 1 mm, ovules 2. *Fruit* up to 4 by 1½ mm. *Seeds* up to 3 by 1 mm, testa simple; plumule striate, about as long as the embryo, attached near the base of the embryo and fitted in a groove.

Distribution: NW. Madagascar, Districts of Sambirano and Maromandia: valley of the Antsahakolany, *Decary 2154* (P); environs of Maromandia (Beraty), *Decary 1599* (P); Be Nilus Mountains, *J. T. Last s.n.* (K); Mountains at source of Sambirano River, *J. T. Last s.n.* (BM).

Ecology: Running streams and rapids; obviously flowering throughout the year.

Note. *Decary's* collection 1599 was in the Flore de Madagascar referred to *A. viridis*. In fact, there is a resemblance in habit and in the structure of the embryo. *A. longiplumulosus*, however, can easily be distinguished from *A. viridis* by the robust, densely flowered inflorescence, the long, pink-violet tepals, and the ovaries with only 2 ovules. The plumule of *A. longiplumulosus* is distinctly striate, that of *A. viridis* is not.

9. *Aponogeton viridis* Jumelle, Ann. Mus. Colon. Mars. [III, IV—2 (1916) 28, *nomen*] X—I (1922) II. — *A. ulvaceus* var. *viridis* Jumelle, Fl. Madag. 23 (1936) 12, fig. V 2, *pro parte*. — Type: *Perrier de la Bâthie 393 bis* (P, 4 sheets, one indicated type, the others isotype). — Fig. 2, 10; map 3.

Tuber small, globular, 5—6 mm \varnothing . *Leaves* submerged; leaf-blade up to 25 cm by 13 mm, slightly undulate or crisped; base narrowly cuneate, apex cuneate and often acuminate; on either side of the midrib 2 or 3 parallel nerves; petiole up to 8 cm. *Peduncle* up to 30 cm, not or hardly thickening towards the inflorescence; spathe up to 8 mm with a short acumen (3 mm), caducous; inflorescence with 2 spikes of up to 30 mm, laxly flowered. *Flowers* turned towards all directions. Tepals 2, oval or orbicular, $\frac{1}{2}$ —1 mm by nearly $\frac{3}{4}$ mm, white, 1-ribbed. Stamens 6, \pm 1 $\frac{1}{2}$ mm; filaments strongly widening towards the base and applanate. Ovaries 3, up to 1 $\frac{1}{2}$ by $\frac{3}{4}$ mm; ovules 4(—6). *Infructescence* up to 7 cm. *Fruit* up to 3 $\frac{1}{4}$ by 2 mm. *Seeds* up to 2 $\frac{1}{2}$ by 1 $\frac{1}{2}$ mm, testa simple; plumule without veins or other markings, attached at about $\frac{1}{4}$ of the height of the embryo, rather long and fitted in a shallow groove.

Distribution: Districts of Maewatanana and Analalava.

Ecology: Rivulets with running water on lias formation. Flowering time at least September—November.

Note. *A. viridis* was in the Flore de Madagascar as a variety referred to *A. ulvaceus*. There is such a striking difference, however, in habit and in the structure of flower and seed between these taxa that they must be considered distinct species.

10. *Aponogeton capuronii* van Bruggen, *sp. nov.* — Type: District of Fort-Dauphin: Ebakika, River Mamery, 12-7-1923, *Decary 10101* (P, 3 sheets, one indicated type, the others isotype). — Fig. 2: 6; 3a—b; map 4.

Tuber ovatum vel globosum, usque ad 2 cm \varnothing . *Folia* submersa; laminae 20—40 cm longae, ad 3(4 $\frac{1}{2}$) cm latae, applanatae vel valde undulatae, ferrugineae vel ex nigro virides, basi cuneatae, rotundatae vel subcordatae, apice late cuneatae vel rotundatae, obtusae; costa lata in utroque latere nervis parallelis 3—5 comitata; petiolus ad 20 cm longus. *Pedunculus* 40—60(—300) cm longus, inflorescentiam versus sensim incrassatus; spatha c. 1 $\frac{1}{2}$ cm longa, breviter (2 mm) acuminata, caduca; inflorescentia 2 (rarissime 3)—spicata, spicis ad 14 cm longis, sat densiflora. *Flores* omnifarii. Tepala 2, irregularia, interdum latiores quam longiores, 1 $\frac{1}{2}$ —1 $\frac{3}{4}$ \times $\frac{3}{4}$ —1 $\frac{3}{4}$ mm, alba, uninervia. Stamina 5—8, c. 2 mm longa, filamentis basin versus elatis. Ovaria 3 (vel 4), 1 $\frac{1}{2}$ \times $\frac{3}{4}$ mm, spiculata, ovulis (2—)4. *Infructescentia* fere 20 cm longa. *Fructus* paene 6 \times 3 mm, saepe irregulariter spiculatus. *Semina* ad 3 $\frac{1}{4}$ \times 1 $\frac{1}{2}$ mm, pyriformia, testa una; plumula fere ad basin embryonis inserta atque in sulco angusto inter cotyledonis margines apta vel eis quidem obiecta.

Tuber ovate or globular, up to 2 cm \varnothing . *Leaves* submerged, leaf-blades 20—40 by up to 3 (4 $\frac{1}{2}$) cm, flat or strongly undulate, brownish or blackish-green; base cuneate, rounded, or slightly cordate, apex broadly cuneate or rounded, blunt; midrib wide, 3—5 parallel nerves on either side; petiole up to 20 cm. *Peduncle* 40—60(—300!) cm, gradually thickening towards the inflorescence; spathe \pm 1 $\frac{1}{2}$ cm long, with a short acumen (2 mm), caducous; inflorescence with 2, very rarely 3 spikes of up to 14 cm, rather densely flowered. *Flowers* turned towards all directions. Tepals 2, irregularly shaped, sometimes wider than long, 1 $\frac{1}{2}$ —1 $\frac{3}{4}$ by $\frac{3}{4}$ —1 $\frac{3}{4}$ mm, white, 1-ribbed. Stamens 5—8, \pm 2 mm, filaments widening towards the base. Ovaries 3 or 4, 1 $\frac{1}{2}$ by $\frac{3}{4}$ mm, spiculate, ovules (2—)4. *Infructescence* almost 20 cm. *Fruit* nearly 6 by 3 mm, often irregularly spiculate. *Seeds* up to 3 $\frac{1}{4}$ by 1 $\frac{1}{2}$ mm, pear-shaped, testa single; plumule attached

near the base of the embryo and fitted in a narrow groove between the margins of the cotyledon or even covered by them.

Distribution: District of Fort-Dauphin: River Mamery (= Manery = Bakika), *Decary 10101* (P); Rivulet Mandromondromotra, ± 20 km N. of Fort-Dauphin, *Bogner 202* (L); Fort-Dauphin, *Catat 4315* (P); Defile of Leongato, *Decary 10612* (P); between the mountain-top St. Louis and the sea, *Humbert 5990* (P).

Ecology: Shallow rivers and lagoons with fast running and acid water. The tubers are rooted in gravel between stones on gneiss (partly Bogner in litt.). Probably flowering throughout the year.

Notes. *Decary's* collections *10101* and *10612* were in the Flore de Madagascar referred to *A. boivinianus*. *A. capuronii*, however, can easily be distinguished from the latter by the not bullate leaves and the entirely different structure of flowers and embryo. I named the species after Mr R. Capuron at Tananarive, in gratitude for his assistance to this revision by supplying living plants.

II. *Aponogeton ulvaceus* Baker, Journ. Linn. Soc. Bot. 18 (1881) 280 '*ulvaceum*'; Engler et Krause, Pfl. R. Heft 24 (1906) 17, fig. 5; Jumelle, Fl. Madag. 23 (1936) 12, fig. IV 1, *excl. syn. A. viridis et var. viridis* Jumelle. — Type: *Langley Kitching s.n.* (K). — **Fig. 2: 7; pl. III & IV; map 4.**

A. ambongensis Jumelle, Ann. Mus. Col. Marseille, [III, IV—2 (1916) 28, *nomen*] X—I (1922) 11. — *A. ulvaceus* Baker var. *ambongensis* Jumelle, Fl. Madag. 23 (1936) 12, fig. V 1. — Type: *Perrier de la Bâthie 1546* (P, 2 sheets, one indicated type, the other isotype).

Tuber globular or ovate, up to 3 cm \varnothing ; often echinate all round the growing apex. *Leaves* all submerged; leaf-blades 12—35 by 2—8 cm, very thin and transparent, bright green, flat or undulate, sometimes even contorted; base narrowly cuneate till rounded, apex cuneate or rounded, blunt or acute, sometimes retuse: midrib wide, with 3—5 parallel nerves on either side; petiole 7—25 cm. *Peduncle* up to 80 cm, strongly thickened towards the inflorescence; spathe $\pm 1\frac{1}{2}$ cm with a long acumen ($1\frac{1}{2}$ —5 cm), caducous; inflorescence with 2 spikes, spikes up to 15 cm, rather densely flowered, fragrant. *Flowers* turned towards all directions. Tepals 2 (narrowly) obovate and often clawed, $1\frac{1}{2}$ — $2\frac{1}{2}$ by $\frac{3}{4}$ mm, 1-ribbed, white, yellow, sometimes violet. Stamens 6, 2— $2\frac{1}{2}$ mm; filaments not or hardly widening towards the base; anthers pale-yellow, pollen yellow. Ovaries 3, $1\frac{1}{2}$ — $2\frac{1}{2}$ by $\frac{3}{4}$ mm; ovules 4—6. *Fruits* $3\frac{1}{2}$ —5 by 2—3 mm with a terminal beak. *Seeds* $1\frac{1}{2}$ —3 by $\frac{1}{2}$ —1 mm; testa double, outer one loose, transparent, and distinctly reticulately veined, inner one brown, closely fitting the embryo. Embryo $\frac{3}{4}$ — $1\frac{1}{2}$ by $\frac{1}{2}$ — $\frac{3}{4}$ mm, plumule absent.

Distribution: Central, West and Northwest Madagascar.

Ecology: Stagnant or fast running, sometimes calcareous water, torrents, marshes, both in sunny and shaded positions. Obviously flowering Oktober—April.

Note. *A. ambongensis* differs from *A. ulvaceus* only by the smaller dimensions of all parts of the plants. *A. ulvaceus* is very often cultivated in Europe by aquarists. It appears that the plants, perhaps under the influence of the supply of nutrition, are extremely variable in size. The same specimen can reach huge dimensions in one place and hardly reach the dimensions of *A. ambongensis* in another. Consequently I do not consider *A. ulvaceus* var. *ambongensis* a good variety.



Plate I. *A. decaryi* Jum., left: habit, right: ♀ inflorescence.



Plate II. Left: *A. decaryi* Jun., ♂ inflorescence. Right: *A. boivinianus* Baill. ex Jun., tuber.

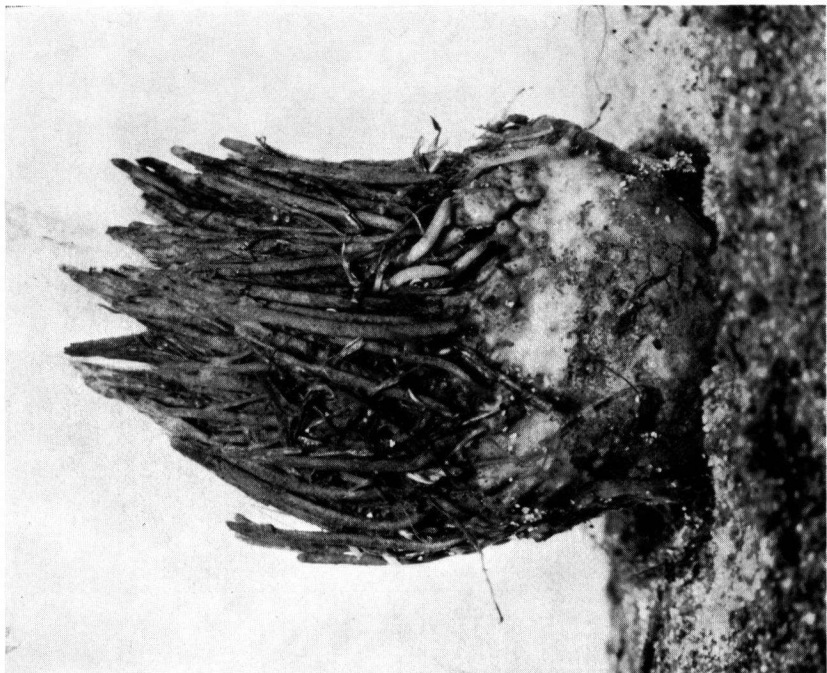
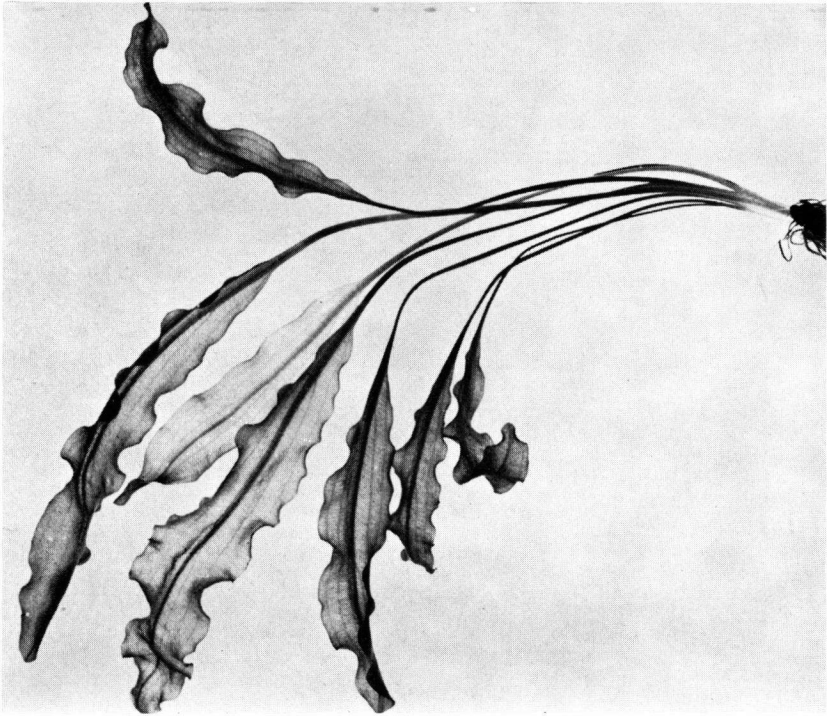


Plate III. *A. uluaceus* Baker, left: a tuber, right: habit of young specimen.

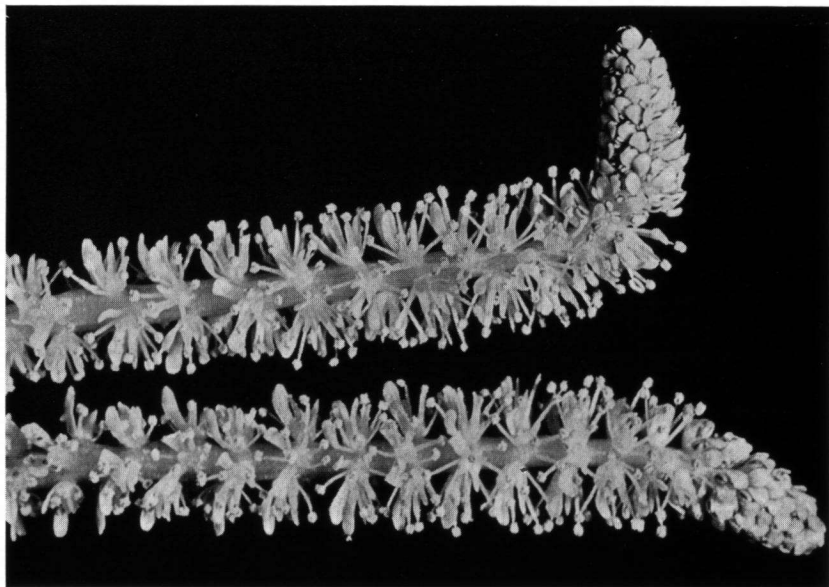
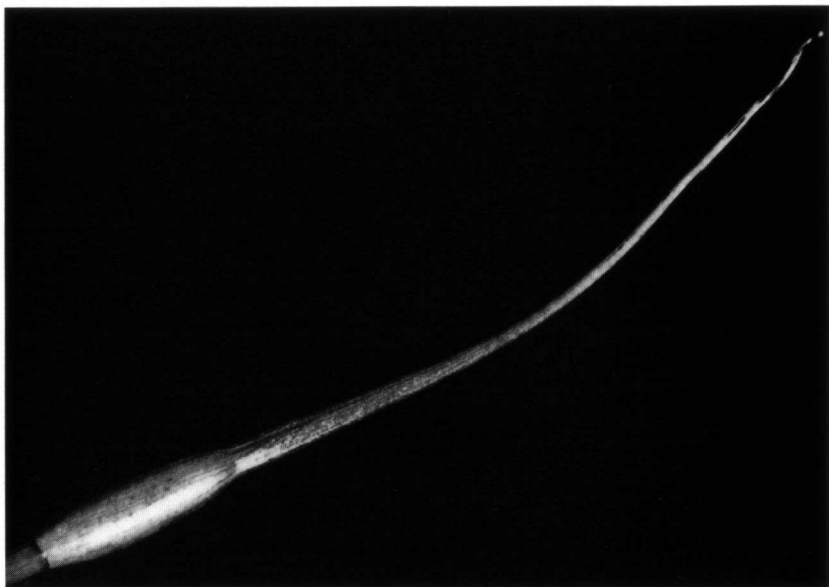


Plate IV. *A. ulvaceus* Baker, left: inflorescence, right: mature spathe.



IDENTIFICATION LIST

In this list collectors' names have been arranged alphabetically. Specimens without number are indicated with 's.n.' and provided with the date of collection if any was mentioned. All collections are provided with the standard abbreviation of the Herbarium in which the author studied them; type collections are indicated.

- Afzelius s.n. (4-4-1912, K): 11. d'Alleizette s.n. (1905, L): 1; s.n. (3-1906, L): 1; s.n. (29-10-1909, L): 11; 923M (P): 1.
- Baron 547 (P): 11; 1458 (P): 1; 1599 (P): 6. Baschet s.n. (P): 1 (Mauritius). Bernier s.n. (type, P): 6; s.n. (1834, P): 6. Bogner 193 (L): 1; 194 (L): 6; 202 (L): 10; 203 (L): 1; 210 (L): 2; 212 (L): 1; 213 (L): 6; 214 (L): 1. Boivin s.n. (P): 1; s.n. (P): 5; 1699 (P): 6; 2018 (P): 5. Bojer s.n. (P): 1. Bosser 10908 (type, P): 2; 13024 (P): 1; 17877 (P): 3; 18519 (P): 6; 18735 (P): 3; 19802 (L, P): 2. Breon s.n. (P): 1. Bühner s.n. (P): 1.
- Campenon s.n. (P): 1. Catat 1314 (P): 1; 4315 (P): 10. Chapelier s.n. (P): 1. Corréard s.n. (P): 1. Cours 872 (P): 1; 1016 (P): 6; 2780 (P): 6; 4684 (P): 6.
- Decary s.n. (P): 1; s.n. (L): 1; s.n. (P): 10; 46 (P): 5; 1048 (P): 1; 1599 (P): 8; 1605 (P): 11; 2154 (type P): 8; 4961 (P): 1; 7963 (P): 1; 8103 (P): 1; 9400 (type, P): 3; 9539 (P): 3; 10101 (type, P): 10; 10612 (P): 10; 13862 (P): 1; 14929 (P): 1; 15719 (L, P): 11; 15765 (P): 11; 18029 (P): 1; 18227bis (P): 1; 18372 (P): 1; 18379 (P): 1; 18483bis (P): 1. Douillot s.n. (P): 1.
- Gay s.n. (P): 1; 6709 (P): 1; 7796 (P): 6; 7797 (P): 6; 7896 (P): 6; 7897 (P): 1; 7935 (P): 1; 8108 (P): 6; 8109 (P): 6; 8264 (P): 1; 8265 (P): 1; 8266 (P): 1; 8267 (P): 1; 8268 (P): 1; 8269 (P): 1. Geneaud 14 (P): 1. Goudot s.n. (L, P): 1. Grevé s.n. (P): 1. Guillot 5 (K, P): 1.
- Hildebrandt 3116 (P): 1; 3802 (P): 11. Homolle 190 (P): 5. Humbert 2322 (P): 1; 5990 (P): 10; 17897 (P): 6; 24865 (L, P): 11. Humblot 220 (P): 1; 650 (P): 1.
- Lam et Meeuse 5708 (L, P): 6; 5780 (L, P): 6; 5785 (L): 1; 5890 (L, P): 6. Langley Kitching s.n. (1880, P): 1; s.n. (K): 6; s.n. (type, P): 11. Last s.n. (BM): 8; s.n. (K): 8. de Lastelle s.n. (P): 1. Léandri 181 (P): 1. Louvel s.n. (P): 1.
- Malzy s.n. (P): 6. Marie s.n. (P): 1; s.n. (P): 5 (Mayotte). le Myre de Vilers s.n. (P): 1. le Normand s.n. (1852, P): 1.
- Prince H. d'Orléans s.n. (P): 1.
- Peltier 5772 (P): 1. Perrier de la Bâthie 282 (P): 1; 393 (P): 9; 393bis (type, P): 9; 1546 (P): 11; 7143 (K, P): 9; 7144 (P): 1; 7145 (P): 5; 7149 (P): 1; 7153 (P): 6; 7160 (type, P): 7; 7167 (P): 6; 15439 (P): 11; 17579 (P): 11; 17669 (P): 5; 17865 (P): 11; 18076 (P): 1; 18574 (P): 1; 18894 (P): 1. Pervillé s.n. (P): 10; s.n. (1841, P): 5; 420 (type, P): 5. du Petit-Thouars s.n. (type, P): 1.
- Rakotozafy 544 (type, P): 4.
- Service forestier 12 (P): 11. Seyrig 441 (P): 3.
- Tsilizy 10296 (L, P): 1.
- Viguiet et Humbert 742 (P): 6; 743 (P): 1.
- Waterlot 145 (P): 1; 382 (P): 5.

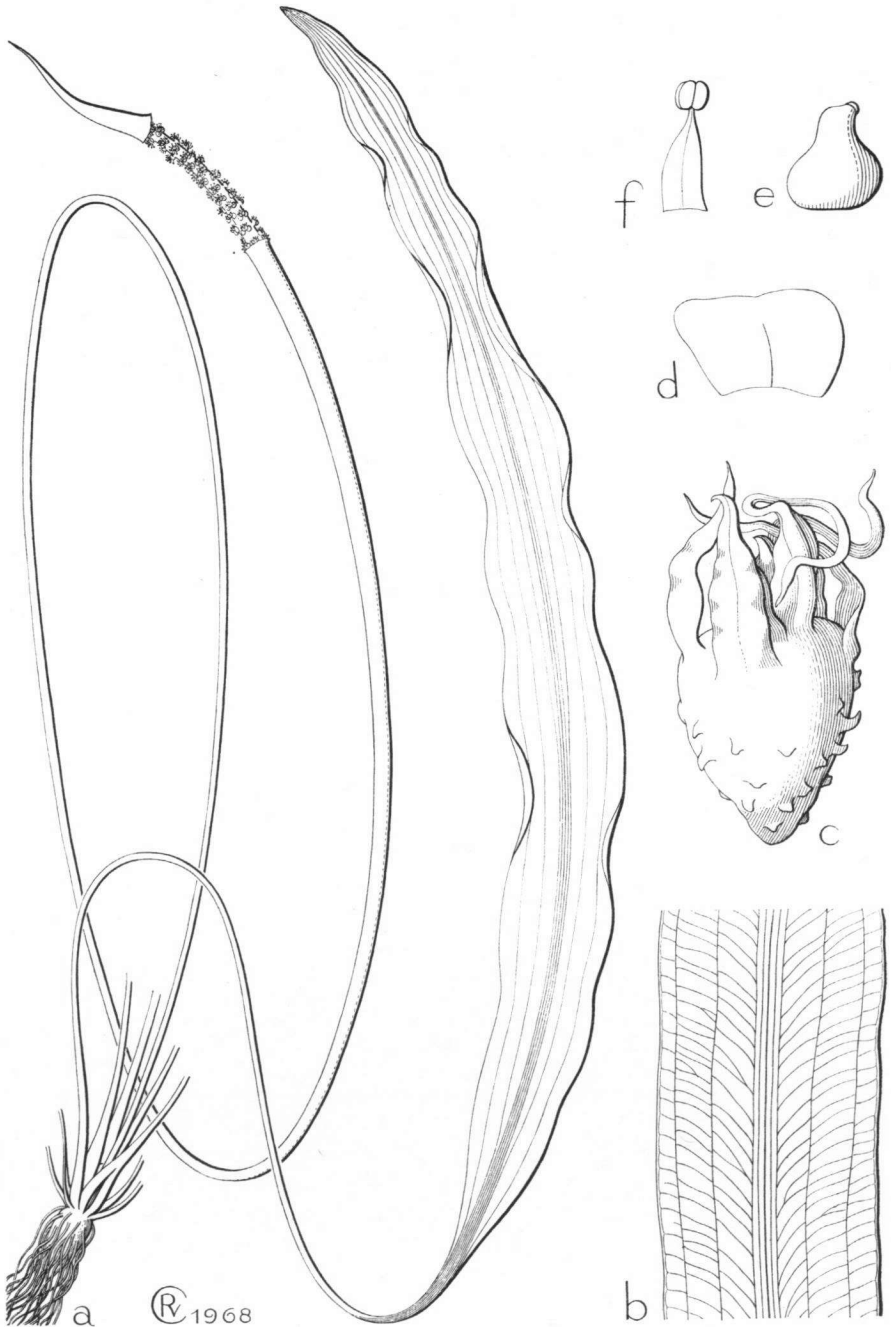


Fig. 5. *A. appendiculatus* Bruggen. a. Habit, $\times \frac{1}{2}$, b. detail of leaf, nat. size, c. embryo, $\times 5$, d. tepal, $\times 14$, e. ovary, $\times 14$, f. stamen, $\times 14$. (a—b, d—f Lawson 113, c. Vencoba Rao 4073).

II, A NEW SPECIES OF APONOGETON FROM INDIA

Aponogeton appendiculatus van Bruggen, *sp. nov.* — Type: Aleppy, Nov. 1893, *M. A. Lawson 113* (K, 2 sheets, one indicated holotype, the second isotype). — Fig. 5.

Tuber c. 1 cm \emptyset , probabiliter elongatum atque repens. *Folia* omnia submersa, 25—40 cm longa, usque ad 3 cm lata, plana vel subundulata, basi anguste cuneata, apice anguste cuneata, acuta vel obtusa; costa dilatata, in utroque latere nervis parallelis 2—4 comitata; petiolus 13—25 cm longus. *Pedunculus* usque ad 1 m longus, inflorescentiam versus sensim incrassatus; spatha 5—6 cm, caduca, attenuata; inflorescentia sat laxiflora, c. 15 cm longa, e spica singula composita. *Flores* omnifarii, exigui. *Tepala* 2, fere semper latiora quam longiora, $\frac{3}{4}$ —1 by 1—1 $\frac{1}{2}$ mm, probabiliter alba, unicostata. *Stamina* (4—)5(—6), c. 1 mm, filamentis basin versus dilatatis. *Ovaria* 2(—3), c. 1 \times $\frac{1}{2}$ — $\frac{3}{4}$ mm, uniovulata. *Fructus* 1 $\frac{1}{4}$ \times $\frac{1}{2}$ — $\frac{3}{4}$ cm, rostrata, rostro terminali. *Embryo* valde insolitus, c. 1 \times $\frac{1}{2}$ cm, obovatus, tuberosus, verticillo appendicium linearum tortuosorum coronatus; appendices usque ad 5 \times 1 $\frac{1}{2}$ mm, apice obtusi vel acuti; testa probabiliter simplex.

Tuber \pm 1 cm \emptyset , probably elongate and creeping. *Leaves* all submerged; leaf-blades 25—40 by up to 3 cm, flat or slightly undulate; base narrowly cuneate, apex narrowly cuneate and acute or blunt; midrib wide with 2—4 slender parallel nerves on either side; petiole 13—25 cm. *Peduncle* up to 1 m, gradually thickening towards the inflorescence; spathe 5—6 cm, attenuate, caducous; inflorescence rather laxly flowered, about 15 cm, spike solitary. *Flowers* turned towards all directions, very small. *Tepals* 2, nearly always wider than long, $\frac{3}{4}$ —1 by 1—1 $\frac{1}{2}$ mm, probably white, 1-ribbed. *Stamens* (4—)5(—6), \pm 1 mm, filaments widened towards the base. *Ovaries* 2(—3), \pm 1 by $\frac{1}{2}$ — $\frac{3}{4}$ mm, ovule 1. *Fruit* 1 $\frac{1}{4}$ by $\frac{1}{2}$ — $\frac{3}{4}$ cm, with a terminal beak. *Embryo* very unusual, \pm 1 by $\frac{1}{2}$ cm, obovate, tuberosus, crowned with a whorl of linear, tortuous appendages of up to 5 by 1 $\frac{1}{2}$ mm with a blunt or acute tip; testa probably simple.

Distribution: S.W. India, between Cochin and Aleppy: Aleppy, *M. A. Lawson 113* (K); Vembanad Lake between Cochin and Aleppy, K. *Vencoba Rao 4073* (K); Canal near Ambalapuzha (= Aleppy), K. *Rungachari s.n.* (K).

Ecology: Submerged in shallow water; flowered in November.

Notes. With regard to the shape of the embryo *A. appendiculatus* shows resemblance to *Cryptocoryne ciliata* (Roxb.) Fisch. ex Wydl. *C. ciliata* is known to live mostly in mangroves, saltwater creeks and brackish river-mouths (*Nypa*-formation). The shape of the embryo is sometimes considered to be an adaptation to this environment. If the Vembanad Lake is also brackish—and this is not unlikely—the similarity of the shape of the embryo might be ascribed to parallel evolution in a similar habitat. A closer investigation is desirable.

Though the collections cited above were not all mentioned in Gamble, Fl. Pres. Madras 3 (1931) 1597, C. E. C. Fischer labelled them as *A. crispus* Thunb. for the Flora of Madras. *A. crispus* Thunb., however, has hitherto only been found in Ceylon and does not occur in India.

In habit *A. appendiculatus* shows resemblance with *A. rigidifolius* van Bruggen from Ceylon, which has, however, a much shorter spathe (\pm 2 cm), 2 ovules, and a normal embryo. By the structure of the embryo *A. appendiculatus* cannot be confused with any other species of *Aponogeton*.