

# Cyanophyceae associated with mangrove trees at Inhaca Island, Mozambique

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**Keywords:** Bostrychietum, Cyanophyceae, epiphytes, Inhaca Island, mangrove, taxonomy

## ABSTRACT

A survey of the Cyanophyceae associated with two of the five mangrove trees and their associated Bostrychieta at Inhaca Island, Mozambique, was undertaken. Sixteen taxa belonging to 12 genera were identified. Of these, six taxa were new records for Mozambique, three at generic and three at specific level. Thirteen taxa of Cyanophyceae were found growing on *Avicennia marina* (Forssk.) Vierh. and four on *Ceriops tagal* (Perr.) C.B. Robinson. *Chamaecalyx leibleiniae* (H. Reinsch) Komarek & Anagnostidis was the only Cyanophyceae to occur on both species of tree.

## UITTREKSEL

'n Opname van Cyanophyceae wat geassosieer word met twee van die vyf mangrietbome en hul geassosieerde Bostrychieta op Inhaca Eiland, Mosambiek, is gedoen. Sestien taksons wat aan 12 genera behoort, is geïdentifiseer. Ses van hierdie taksons was nuwe rekords vir Mosambiek, drie op genusvlak en drie op spesievlak. Daar is gevind dat dertien Cyanophyceae-taksons op *Avicennia marina* (Forssk.) Vierh. groei en vier op *Ceriops tagal* (Perr.) C.B. Robinson. *Chamaecalyx leibleiniae* (H. Reinsch) Komarek & Anagnostidis was die enigste Cyanophyceae wat op albei boomspesies voorgekom het.

## INTRODUCTION

After a long period of neglect, some attention has recently been given to epiphytic Cyanophyceae associated with mangroves with respect to their abundance and importance within this particular habitat (Berjak *et al.* 1977; Dor 1984; Lambert *et al.* 1989).

The Cyanophyceae from southern African mangroves were studied in detail by Lambert *et al.* (1989). This report constitutes an important contribution to our knowledge of the ecology and taxonomy of the Cyanophyceae in that region. The northern limit of sampling by Lambert *et al.* (1989) was in the Kosi Estuary which borders Mozambique (Figure 1B). Inhaca Island is situated  $\pm$  180 km to the north, on the east coast of southern Africa, within the Indo-West-Pacific biogeographic zone of the degree squares 2532DD and 2632BB (see Edwards & Leistner 1971) (Figure 1A, B). It is of interest because of the well-zoned mangrove swamps, a feature not apparent in the swamps to the south (Berjak *et al.* 1977). The island is situated in the south of Mozambique, forming part of the barrier between the Indian Ocean and Maputo Bay (Figure 1). The largest stands of mangroves are located at the head of the northern and the southern bays (Figure 1C) (Macnae & Kalk 1969).

The mangrove vegetation on Inhaca Island is mainly composed of the following: *Avicennia marina* (Forssk.) Vierh., *Bruguiera gymnorrhiza* (L.) Lam., *Ceriops tagal* (Perr.) C.B. Robinson, *Lumnitzera racemosa* Willd. and *Rhizophora mucronata* Lam. *Ceriops tagal* occupies the central areas of all mangrove swamps on the island and macroscopic growth of algae on its trunks is generally very scarce. *Avicennia marina* is a dominant member of the mangrove community. The pneumatophores very often

possess a covering of several species of Rhodophyceae which are collectively known as 'Bostrychietum', which is defined thus by the predominance of species such as *Bostrychia* spp., *Catenella* spp., *Caloglossa* sp. and *Murrayella* sp. (Post 1936; Macnae & Kalk 1962).

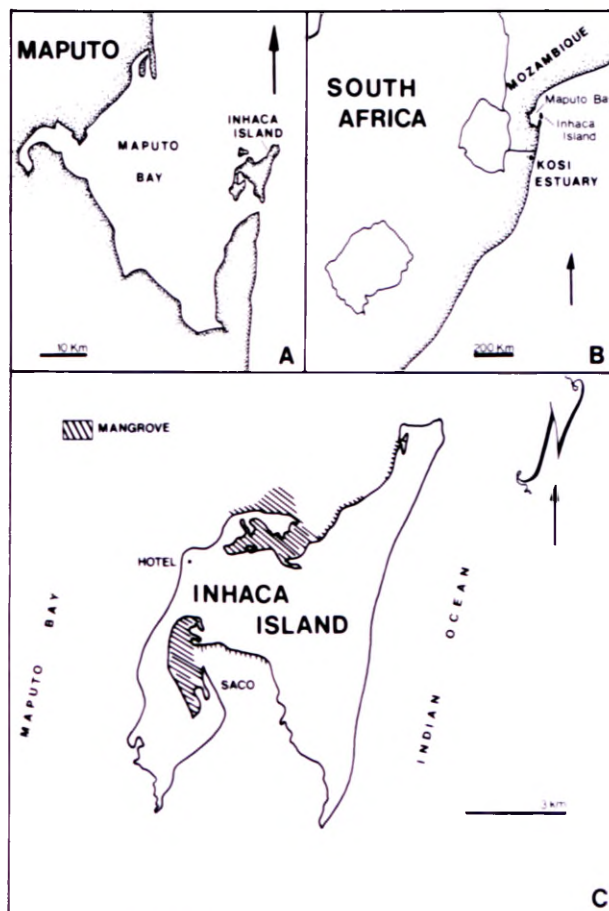


FIGURE 1.—Localization of the study site.

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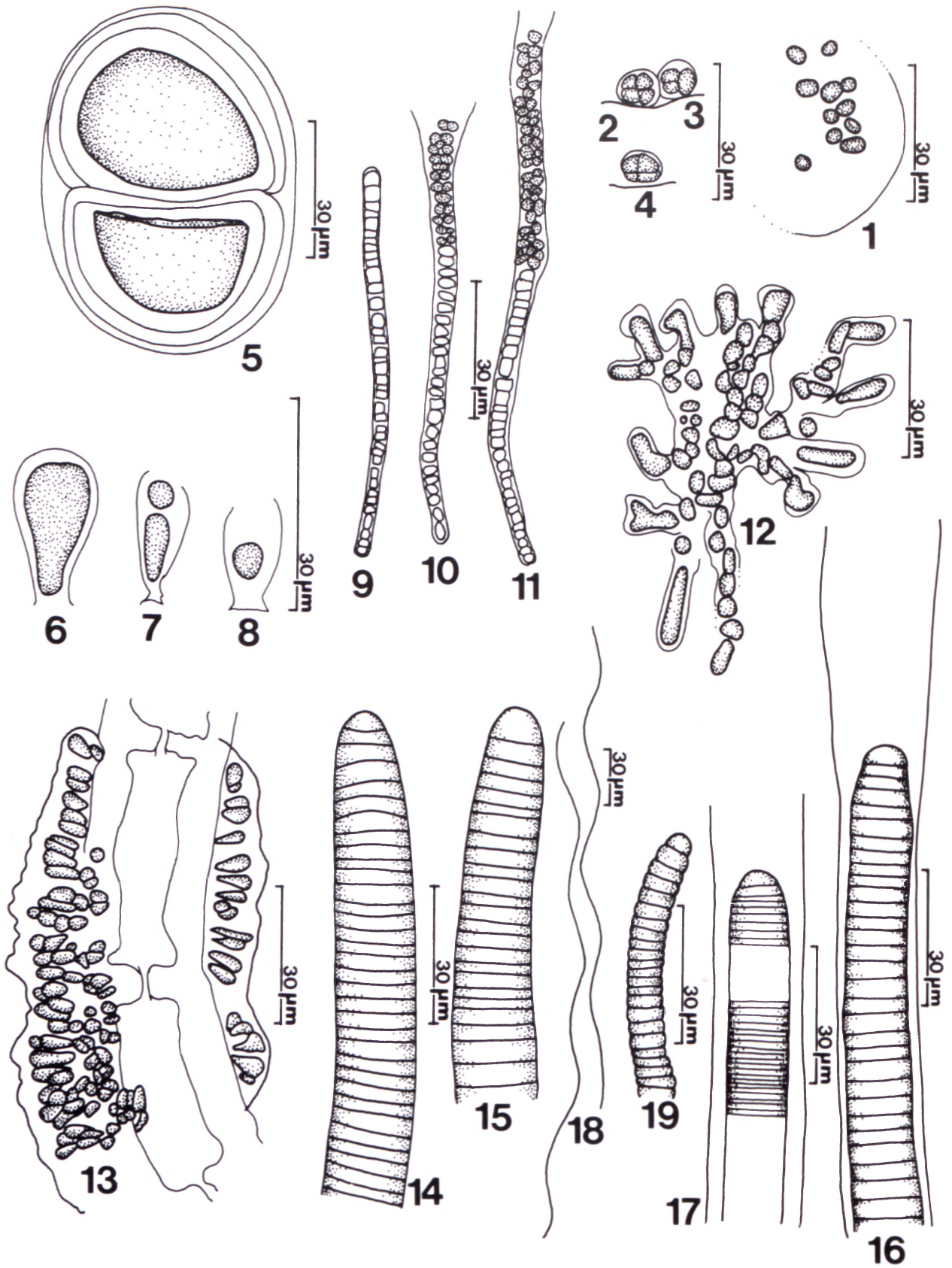


FIGURE 2.—1, *Aphanothece stagnina*, detail of part of a colony. 2–4, *Chroococcus minor*. 5, *C. turgidus* var. *maximus*. 6–8, *Chamaecalyx leibleiniae*: 6, young plant; 7, exocytosis in a colony; 8, liberation. 9–11, *Stichosiphon* sp.: 9, young plant; 10, 11, formation and liberation of exocytosis. 12, *Hydrococcus rivularis*, apical view of the filaments radiating from pseudoparenchyma. 13, *Xenococcus acervatus*, apical and lateral view. 14, 15, *Oscillatoria jenensis*, detail of trichomes. 16, *Lyngbya nigra*. 17, *L. confervoides*. 18, 19, *Arthrospira platensis*: 18, general aspect of the filaments; 19, detail of the trichomes.

No research on the Cyanophyceae associated with the mangroves of Mozambique has yet been undertaken. The aim of this study was to identify those algae growing on mangrove trees as well as to contribute to our knowledge of their taxonomy and ecology in southern Africa.

#### MATERIALS AND METHODS

Two substrata which support the growth of benthic algae were considered for this study, viz.: the pneumatophores of *Avicennia marina* and the base of the trunks of *Ceriops tagal*. Sampling was carried out in the northern bay and at Saco during low tide. Twenty samples of the pneumatophores were collected at random, cutting them near the mud surface. In the case of *C. tagal*, trunk segments were removed. Macro-algal hosts within the Bostrychieta were noted. The number of samples analysed was not sufficient to indicate any marked changes in algal composition from the water's edge to the upper limit of the pneumatophores.

Some material was preserved in 4% formalin, and some was allowed to dry in subdued lighting. All samples were deposited at the Herbarium of the Faculty of Biology (LMU), University Eduardo Mondlane in Maputo, Mozambique.

The system of classification used was Anagnostidis & Komarek (1985, 1988) and Komarek & Anagnostidis (1986, 1989).

#### RESULTS

##### Key to the species

- 1a Thallus unicellular or colonial:
  - 2a Unicellular ..... *Chamaecalyx leibleinia*
  - 2b Colonial:
    - 3a Pseudoparenchymatous ..... *Xenococcus acervatus*
    - 3b Not pseudoparenchymatous, subspheric or elongate:
      - 4a Many cells per colony ..... *Aphanothece stagnina*
      - 4b Up to 4 cells per colony:
        - 5a Cells 3.1–4.3  $\mu\text{m}$  broad ..... *Chroococcus minor*
        - 5b Cells 31.8–38.1  $\mu\text{m}$  broad ..... *C. turgidus* var. *maximus*
  - 1b Thallus filamentous or pseudofilamentous:
    - 6a Pseudofilamentous:
      - 7a Pseudofilaments irradiating from pseudoparenchyma ..... *Hydrococcus rivularis*
      - 7b Pseudofilaments single, not forming pseudoparenchyma ..... *Stichosiphon* sp.
    - 6b Filamentous:
      - 8a With heterocysts:
        - 9a Heterocysts intercalary only ..... *Nodularia* sp.
        - 9b Heterocysts terminal:
          - 10a Heterocysts terminal only, cells 9.6–11.8  $\mu\text{m}$  broad ..... *Calothrix scopulorum*
          - 10b Heterocysts terminal and intercalary, cells 19.8–28.1  $\mu\text{m}$  broad ..... *C. crustacea*
      - 8b Without heterocysts:
        - 11a Sheath absent:
          - 12a Trichomes regularly spirally coiled ..... *Arthrospira platensis*
          - 12b Trichomes bent, not regularly spirally coiled ..... *Oscillatoria jenensis*
        - 11b Sheath present:
          - 13a Many trichomes per sheath ..... *Microcoleus chthonoplastes*
          - 13b Only one trichome per sheath:
            - 14a Sheath thick, lamellated, filaments 50.0–52.1  $\mu\text{m}$  broad ..... *Lyngbya majuscula*
            - 14b Sheath thin, unlamellated, filaments 6.2–20.6  $\mu\text{m}$  broad:
              - 15a Filaments 17.1–18.7  $\mu\text{m}$  broad ..... *L. nigra*
              - 15b Filaments 19.0–20.6  $\mu\text{m}$  broad ..... *L. confervoides*

#### CHROOCOCCALES

##### Microcystaceae

**Aphanothece stagnina** (*C.K. Spreng.*) *A. Braun*, In Rabenhorst: 66 (1865); Tilden: 32 (1910); Geitler: 164 (1932); Desikachary: 137 (1959); Humm & Wicks: 49 (1980) [= *Coccochloris stagnina* Drouet & Daily].

*Thallus* generally subspherical,  $\pm 102.5 \mu\text{m}$ . *Sheath* colourless, lamellated, up to  $15.6 \mu\text{m}$  thick. *Cells* oblong or polygonal by mutual compression,  $3.1\text{--}5.6 \times 2.8\text{--}3.4 \mu\text{m}$ , protoplasm homogeneous blue-green (Figure 2.1).

##### Specimens examined

MOZAMBIQUE. — 2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, *S. Silva* & *N. Cuamba* 43 (LMU).

Distribution in Mozambique: Gaza: Muchopes, Chidenguele (Rino 1972). 2632 (Bela Vista): Inhaca Island (Rino 1972); marine, on rocks and sand (Silva 1991); Namaacha (Rino 1972). Sul do Save: Rino (1979).

##### Chroococcaceae

**Chroococcus minor** (*Kützing*) *Näg.*: 47 (1849); Tilden: 9 (1910); Geitler: 240 (1932); Desikachary: 105 (1959).

*Colony* subspherical, groups of 3–4 cells. *Sheath* thin, colourless or yellowish lamellated. *Cells* generally hemispherical or subhemispherical, protoplasm homogeneous pale blue-green,  $2.8\text{--}4.0 \times 3.1\text{--}4.3(-6.2) \mu\text{m}$  (Figure 2.2, 2.3, 2.4).

##### Specimens examined

MOZAMBIQUE. — 2632 (Bela Vista): Inhaca Island, near the northern bay, 14-07-1988, *S. Silva* & *N. Cuamba* 26; near the 'Saco Inhaca', 24-06-1988, *S. Silva* & *N. Cuamba* 2 (LMU).

Distribution in Mozambique: 2335 (Inhambane): Vilanculos (Rino 1969).

**Chroococcus turgidus** (*Kützing*) *Näg.* var. **maximus** *Nygaard*: 201 (1926); Tilden: 5 (1910); Geitler: 229 (1932); Desikachary: 102 (1959).

*Colony* subspherical or elongate, groups of 2 cells. *Sheath* colourless, lamellated,  $\pm 11.5 \mu\text{m}$  thick. *Cells* hemispherical,  $17.7\text{--}30.3 \times 31.8\text{--}38.1 \mu\text{m}$ , protoplasm granular dark green. (Figure 2.5).

##### Specimens examined

MOZAMBIQUE. — 2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, *S. Silva* & *N. Cuamba* 43 (LMU).

Distribution in Mozambique: 2335 (Inhambane): Inharrime (Rino 1972). 2632 (Bela Vista): Inhaca Island, marine, on sand (Silva 1991).

##### Chamaesiphonaceae

**Chamaecalyx leibleinia** (*H. Reinsch*) *Komarek* & *Anagnostidis*: 199 (1986); Geitler: 399 (1932) [= *Dermocarpa leibleinia* (*H. Reinsch*) *Born. & Thur.*]; Desikachary: 173 (1959) [= *Dermocarpa leibleinia* (*H. Reinsch*) *Born. & Thur.*]; Humm & Wicks: 62 (1980) [= *Entophysalis conferta* Drouet & Daily].

*Sporangia* single or gregarious, club-shaped, straight or bent,  $22,5-46,8 \times (8,4-10,0-19,6 \mu\text{m})$ , protoplasm homogeneous pale blue-green. *Sheath* thin, colourless. *Exocytetes* many,  $\pm 9, 4,0-8,1 \mu\text{m}$  broad. (Figure 2.6, 2.7, 2.8).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the 'Saco Inhaca', 24-06-1988, S. Silva, N. Cuamba & D. Gove 3; near the northern bay, 14-07-1988, S. Silva & N. Cuamba 25, 28 (LMU).

Distribution in Mozambique: 2632 (Bela Vista): Inhaca Island, marine, on *Cladophora* sp. (Silva 1991).

#### *Stichosiphon* sp.

*Sporangia* single, erect or bent, up to  $122,0 \times 2,5-6,5 \mu\text{m}$ . *Sheath* thin, colourless, homogeneous. *Cells*  $1,5-2,8 \times 1,8-3,4(-4,0) \mu\text{m}$ , protoplasm homogeneous blue-green. *Exocytetes* many,  $\pm 44$ . (Figure 2.9, 2.10, 2.11).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43 (LMU).

Distribution in Mozambique: first record for the occurrence of the genus.

The specimens of *Stichosiphon* Geitl. studied probably constitute a new species. However, more detailed studies in culture should be undertaken in order to elucidate the development and reproduction of this alga.

### Hydrococcaceae

*Hydrococcus rivularis* Kützing: 380 (1833); Tilden: 45 (1910) [= *Oncobirsa rivularis* (Kützing) Menegh.]; Geitler: 362 (1932) [= *Oncobirsa rivularis* (Kützing) Menegh.]; Desikachary: 180 (1959).

*Thallus* dark green, discoid, pseudoparenchymatous. *Pseudofilaments* generally branched, radially arranged. *Sheath* colourless, diffluent, generally indistinct. *Cells*  $(1,5-2,5-4,6 \times 2,5-3,1 \mu\text{m})$  (Figure 2.12).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43; near the 'Saco Inhaca', 24-06-1988, S. Silva & N. Cuamba 2 (LMU).

Distribution in Mozambique: first record for the occurrence of the genus.

### Xenococcaceae

*Xenococcus acervatus* Setch. & N.L. Gardner, In Gardner: 459 (1918); Geitler: 333 (1932); Desikachary: 182 (1959); Humm & Wicks: 62 (1980) [= *Entophysalis conferta* Drouet & Daily].

*Thallus* dark green, lobed, pseudoparenchymatous, single layered. *Sheath* thick, colourless, unlamellated. *Cells*  $5,9-11,2 \times 2,5-3,4 \mu\text{m}$  (Figure 2.13).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43 (LMU).

Distribution in Mozambique: first record for the occurrence of the species.

### OSCILLATORIALES

#### Oscillatoriaceae

*Oscillatoria jenensis* G. Schmid: 572 (1921); Geitler: 949 (1932).

*Trichomes* bent, not constricted at the cross-walls, slightly attenuated or not at the ends. *Cells* 4–9 times broader than long,  $(1,5-2,1-5,3 \times 14,3-19,6 \mu\text{m})$ , cross-walls not granular, protoplasm homogeneous blue-green (Figure 2.14, 2.15).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 14-07-1988, S. Silva & N. Cuamba 25 (LMU).

Distribution in Mozambique: first record for the occurrence of the species.

*Lyngbya nigra* C. Agardh ex Gomont: 145 (1892); Tilden: 119 (1910); Geitler: 1063 (1932); Desikachary: 317 (1959).

*Filaments* long, flexuous,  $17,1-18,7 \mu\text{m}$  broad. *Sheath* thin, colourless, unlamellated. *Trichome* not constricted at the cross-walls, slightly attenuated or not. *Cells* 3–5 times broader than long,  $2,5-4,6 \times 13,4-15,0 \mu\text{m}$ , cross-walls not granular, protoplasm granular blue-green. *Calyptra* roundish (Figure 2.16).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43 (LMU).

Distribution in Mozambique: first record for the occurrence of the species.

*Lyngbya confervoides* C. Agardh ex Gomont: 156 (1892); Tilden: 119 (1910); Geitler: 1061 (1932); Desikachary: 314 (1959); Humm & Wicks: 81 (1980) [= *Microcoleus lyngbyaceus* (Kützing) P.L. Crouan].

*Filaments* long, flexuous,  $19,0-20,6 \mu\text{m}$  broad. *Sheath* thin, colourless, unlamellated. *Trichome* not constricted at the cross-walls, not attenuated at the ends. *Cells* 7–12 times broader than long,  $1,2-2,1 \times 14,0 \mu\text{m}$ , cross-walls not granular, protoplasm homogeneous dark green. *Calyptra* absent (Figure 2.17).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43 (LMU).

Distribution in Mozambique: 2632 (Bela Vista): Inhaca Island, marine, on rocks, on *Crassostrea* sp. and mixed with *Bostrychia* spp. and *Catenella* sp. (Silva 1991); plankton (Silva & Cuamba 1991).

**Lynghya majuscula** Harv. ex Gomont: 151 (1892); Tilden: 123 (1910); Geitler: 1060 (1932); Desikachary: 313 (1959); Humm & Wicks: 81 (1980) [= *Microcoleus lynghyaceus* (Kützing) P.L. Crouan].

*Filaments* long, flexuous, 50.0–52.1  $\mu\text{m}$  broad. *Sheath* colourless, lamellated,  $\pm$  3.4  $\mu\text{m}$  thick. *Trichome* not constricted at the cross-walls, not attenuated at the ends. *Cells* 9–10 times broader than long, 2.1–5.0(–10.9)  $\times$  39.0–45.0  $\mu\text{m}$ , cross-walls not granular. *Protoplasm* homogeneous dark green. *Calyptra* absent (Figure 3.1).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43 (LMU).

Distribution in Mozambique: 2335 (Inhambane); Massinga (Rino 1972); 2632 (Bela Vista): Inhaca Island, marine (Pocock 1969); mixed with *Bostrychia* spp. and tree trunks in decomposition (Silva 1991); plankton (Silva & Cuamba 1991).

#### Phormidiaceae

**Arthrospira platensis** (Nordst.) Gomont: 247 (1892); Geitler: 919 (1932) [= *Spirulina platensis* (Nordst.) Geitl.]; Desikachary: 190 (1959).

*Trichomes* constricted at the cross-walls, not attenuated at the ends. *Spirals* 75.0  $\mu\text{m}$  distant from each other. *Cells* 3–4 times broader than long, 1.8–3.1  $\times$  7.5–8.4  $\mu\text{m}$ , protoplasm homogeneous blue-green (Figure 2.18, 2.19).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the 'Saco Inhaca' 24-06-1988, S. Silva, N. Cuamba & D. Gove 3 (LMU).

Distribution in Mozambique: first record for the occurrence of the genus.

**Microcoleus chthonoplastes** Thur. ex Gomont: 353 (1892); Tilden: 155 (1910); Geitler: 1133 (1932); Desikachary: 343 (1959); Humm & Wicks: 73 (1980) [= *Schizothrix arenaria* (Berk.) Gomont].

*Filaments* single, bent, unbranched, attenuated to the apex,  $\pm$  80, 0  $\mu\text{m}$ . *Sheath* colourless or yellowish, unlamellated,  $\pm$  24.0  $\mu\text{m}$  thick. *Trichomes* constricted at the cross-walls, cross-walls not granular. *Cells* 0.1–1.4 times broader than long, 5.3–10.3  $\times$  4.3–7.5  $\mu\text{m}$ , protoplasm homogeneous blue-green. *End cells* conical, not capitate (Figure 3.2, 3.3).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43, near the 'Saco Inhaca', 24-06-1988, S. Silva & N. Cuamba 2 (LMU).

Distribution in Mozambique: 2632 (Bela Vista): Inhaca Island, marine, on sand and mixed with *Bostrychia* spp. and *Catenella* sp. (Silva 1991).

### NOSTOCALES

#### Nostocaceae

##### *Nodularia* sp.

*Filaments* single, straight or bent, 16.2–20.0  $\mu\text{m}$  broad. *Sheath* thin, colourless, unlamellated. *Trichome* con-

stricted at the cross-walls. *Cells* generally 3 times broader than long or subquadratic, 3.7–10.9  $\times$  11.5–13.1  $\mu\text{m}$ , protoplasm homogeneous blue-green. *Heterocysts* colourless, depressed spherical or cylindrical, 13.7–15.6  $\times$  11.2–16.8  $\mu\text{m}$ . *Akinetes* not observed (Figure 3.4).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43 (LMU).

The specimens of *Nodularia* Mert. ex Born. & Flah. were not identified to species level due to lack of akinetes.

#### Rivulariaceae

**Calothrix crustacea** Thur. ex Born. & Flah.: 353 (1886); Tilden: 264 (1910); Geitler: 601 (1932); Desikachary: 523 (1959); Humm & Wicks: 151 (1980).

*Thallus* caespitose, dark-green. *Filaments* bent,  $\pm$  1400.0  $\times$  20.0–35.3  $\mu\text{m}$ , slightly swollen at the base, not attenuated into a hair. *Sheath* colourless or yellowish, lamellated,  $\pm$  6.5  $\mu\text{m}$  thick. *Trichome* constricted at the cross-walls. *Cells* generally 0.7–2.0 times longer than broad, (1.5–)3.4–10.9  $\times$  19.6–28.1  $\mu\text{m}$ , protoplasm granular blue-green. *Heterocysts* 1-basal, 1–2-intercalary, protoplasm yellowish, (6.8–)15.3–35.3  $\times$  (12.1–)20.3–27.8  $\mu\text{m}$ . *Hormogonia* not observed (Figure 3.5, 3.6, 3.7).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 14-07-1988, S. Silva & N. Cuamba 26 (LMU).

Distribution in Mozambique: 2632 (Bela Vista): Inhaca Island, marine, on *Crassostrea* sp. (Silva 1991).

**Calothrix scopulorum** (F. Weber & D. Mohr) C. Agardh ex Born. & Flah.: 359 (1886); Tilden: 258 (1910); Geitler: 600 (1932); Desikachary: 524 (1959); Humm & Wicks: 84 (1980) [= *Calothrix crustacea* Schousb. & Thur.].

*Filaments* single, bent,  $\pm$  120.0  $\times$  15.9–17.8  $\mu\text{m}$ , slightly swollen at the base, not tapering into a hair. *Sheath* colourless, unlamellated,  $\pm$  2.8  $\mu\text{m}$  thick. *Trichome* not constricted at the cross-walls. *Cells* 2–6 times broader than long, 2.1–4.3  $\times$  9.6–11.8  $\mu\text{m}$ , protoplasm granular blue-green. *Heterocysts* 1-basal, protoplasm yellowish, 18.4  $\times$  9.6  $\mu\text{m}$ . *Hormogonia* 35.0  $\times$  9.6  $\mu\text{m}$  (Figure 3.8).

#### Specimens examined

MOZAMBIQUE. —2632 (Bela Vista): Inhaca Island, near the northern bay, 07-09-1989, S. Silva & N. Cuamba 43 (LMU).

Distribution in Mozambique: 2632 (Bela Vista): Inhaca Island, marine plankton (Silva & Cuamba 1991).

### DISCUSSION

The Cyanophyceae on mangrove trees at Inhaca Island were found frequently associated with several species of red algae in the so-called 'Bostrychietum' on pneumatophores of *Avicennia marina*. These Cyanophyceae were also found on the base of trunks of *Ceriops tagal* where the number of taxa was lower than that observed on

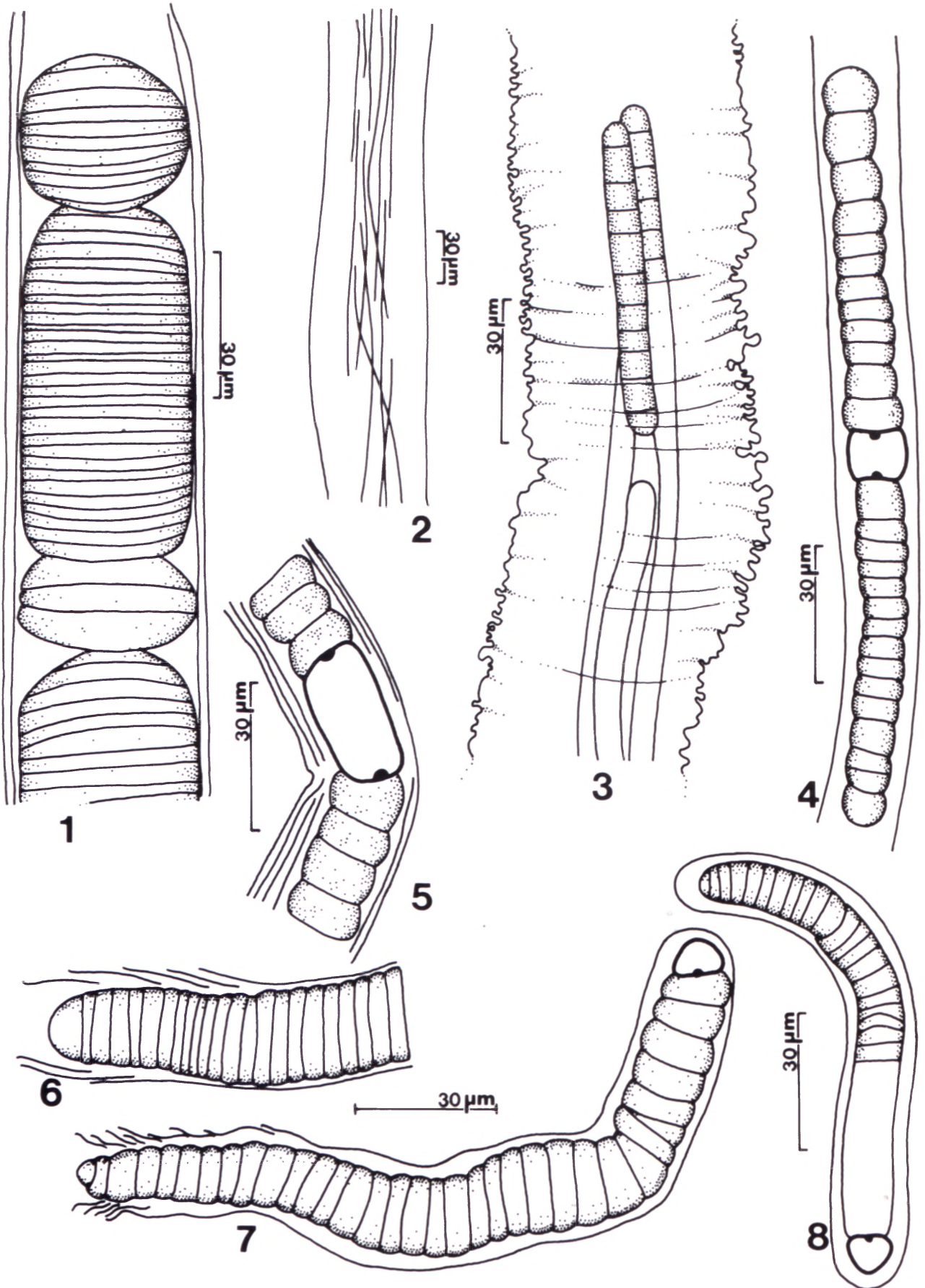


FIGURE 3.—1, *Lyngbya majuscula*. 2, 3, *Microcoleus chthonoplastes*: 2, general aspect of the filament; 3, detail of the trichomes. 4, *Nodularia* sp. 5–7, *Calothrix crustacea*: 5, detail of intercalary heterocysts; 6, detail of apex of a filament; 7, detail of a filament. 8, *C. scopulorum*.

pneumatophores (Table 1). This observation can be explained in that the 'Bostrychietum' offers a suitable micro-habitat for the development of Cyanophyceae where they are less susceptible to extreme environmental conditions such as desiccation, high light intensity and high temperature conditions than on the base of *C. tagal*. Besides, *C. tagal* occurs fairly high up the shore where tidal inundations are less frequent.

Sixteen taxa of Cyanophyceae were identified, which included 12 genera (*Aphanothece*, *Arthrospira*, *Calothrix*, *Chamaecalyx*, *Chroococcus*, *Hydrococcus*, *Lyngbya*, *Microcoleus*, *Nodularia*, *Oscillatoria*, *Stichosiphon* and *Xenococcus*) and 14 species (*Aphanothece stagnina* (C.K. Sprengel) A. Braun, *Arthrospira platensis* (Nordst.) Gomont, *Chroococcus minor* (Kützing) Nägeli, *C. turgidus* (Kützing) Nägeli var. *maximus* Nygaard, *Calothrix crustacea* Thur. ex Born. & Flah., *C. scopulorum* (F. Weber & D. Mohr) C. Agardh ex Born. & Flah., *Chamaecalyx leibleiniae* (H. Reinsch) Komarek & Anagnostidis, *Hydrococcus rivularis* Kützing, *Lyngbya confervoides* C. Agardh ex Gomont, *L. majuscula* Harv. ex Gomont, *L. nigra* C. Agardh ex Gomont, *Microcoleus chthonoplastes* Thur. ex Gomont, *Oscillatoria jenensis* G. Schmid and *Xenococcus acervatus* Setch. & N.L. Gardner. In addition, *Stichosiphon* sp. probably constitutes a new species and *Nodularia* sp. could not be identified further due to the lack of reproductive material. *Arthrospira platensis*, *Hydrococcus rivularis* and *Stichosiphon* sp. are recorded for the first time at the generic level and *Lyngbya nigra*, *Oscillatoria jenensis* and *Xenococcus acervatus* are first records at the specific level for Mozambique.

Of the identified species, 75% were found growing exclusively on *Avicennia marina* and 18% only on *Ceriops tagal*. On *A. marina*, eight taxa were not associated with macroalgae (*Aphanothece stagnina*, *Chroococcus turgidus* var. *maximus*, *Arthrospira platensis*, *Lyngbya nigra*,

TABLE 1.—Mangrove substrata upon which the species of Cyanophyceae were found

Taxon	Substrata						
	<i>Avicennia marina</i>						<i>Ceriops tagal</i>
	A	B	C	Ca	G	M	Ce C Cy
<i>Aphanothece stagnina</i>	+						
<i>Chroococcus minor</i>							+
<i>turgidus</i> var. <i>maximus</i>	+						
<i>Chamaecalyx leibleiniae</i>				+		+	+
<i>Stichosiphon</i> sp.					+	+	
<i>Hydrococcus rivularis</i>		+			+	+	
<i>Xenococcus acervatus</i>		+			+		
<i>Oscillatoria jenensis</i>							+
<i>Arthrospira platensis</i>	+						
<i>Lyngbya nigra</i>	+						
<i>confervoides</i>	+						
<i>majuscula</i>	+						
<i>Microcoleus chthonoplastes</i>	+	+	+		+	+	
<i>Nodularia</i> sp.	+						
<i>Calothrix crustacea</i>							+
<i>scopulorum</i>	+						

A. *Avicennia marina*; B. *Bostrychia* spp.; C. *Caloglossa* sp.; Ca. *Catenella* sp.; Ce, *Ceriops tagal*; Cy, Cyanophyceae; G. *Gelidium* sp.; M. *Murrayella* sp.

TABLE 2.—The diversity of Cyanophyceae recorded from the mangroves of South Africa and Inhaca Island, Mozambique

Taxon	Lambert <i>et al.</i> (1989) southern coast of South Africa	Inhaca Island Mozambique
<i>Aphanocapsa elachista</i> var. <i>conferta</i>	+	
<i>montana</i>	+	
<i>Aphanothece stagnina</i>		+
<i>Arthrospira platensis</i>		+
<i>Chroococcus hansgirgii</i>	+	
<i>minor</i>		+
<i>turgidus</i>	+	
<i>turgidus</i> var. <i>maximus</i>		+
<i>Calothrix contarenii</i>	+	
<i>crustacea</i>		+
<i>scopulorum</i>	+	+
<i>Chamaecalyx leibleiniae</i>		+
<i>Dermocarpa olivacea</i>	+	
<i>Hydrococcus rivularis</i>	+	+
<i>Lyngbya baculum</i>	+	
<i>cinereus</i>	+	
<i>confervoides</i>	+	+
<i>lutea</i>	+	
<i>majuscula</i>		+
<i>nigra</i>		+
<i>Microcoleus chthonoplastes</i>	+	+
<i>Nodularia</i> sp.		
<i>Oscillatoria chlorina</i>	+	
<i>corallinae</i>	+	
<i>jenensis</i>		+
<i>limosa</i>	+	
<i>nigroviridis</i>	+	
<i>proboscidea</i>	+	
<i>schultzei</i>	+	
<i>subbrevis</i>	+	
<i>Phormidium ambiguum</i>	+	
<i>Rivularia bullata</i>	+	
<i>Schizothrix arenaria</i>	+	
<i>Scytonema hofmannii</i>	+	
<i>Spirulina subsalsa</i>	+	
<i>Stichosiphon</i> sp.		+
<i>Xenococcus acervatus</i>	+	+
<i>kernerii</i>	+	

+ presence.

*L. confervoides*, *L. majuscula*, *Nodularia* sp. and *Calothrix scopulorum*), but four were present on at least two different genera of macroalgae (*Chamaecalyx leibleiniae*, *Stichosiphon* sp., *Hydrococcus rivularis* and *Xenococcus acervatus*). *Microcoleus chthonoplastes* was found associated with almost all species of the red algae present on *Avicennia marina*. *C. leibleiniae* was the only epiphytic Cyanophyceae present on both mangrove trees considered in this survey. Only *Chamaecalyx leibleiniae*, *Chroococcus minor*, *Oscillatoria jenensis* and *Calothrix crustacea* were growing on *Ceriops tagal*. *Chamaecalyx leibleiniae* was found associated with *Caloglossa* sp. and *Chroococcus minor* with *Calothrix crustacea*. *O. jenensis* and *C. crustacea* were epiphytic only on the bark of *Ceriops tagal*, and never on macroalgae (Table 1).

Lambert *et al.* (1989) found 27 species of Cyanophyceae (Table 2) on mangroves on the south-east coast of South Africa, of which five are also present at Inhaca Island, namely: *Calothrix scopulorum*, *Hydrococcus rivularis*,

TABLE 3.—Substrata upon which common species of Cyanophyceae were found growing on mangrove swamps from the southern coast of South Africa and Inhaca Island

Taxon	Substrata									
	M	A	B	R	Bo	C	G	Mu	E	Rh
<i>Calothrix scopulorum</i>					*	*		+	*	*
<i>Hydrococcus rivularis</i>					++	*	+	+	*	*
<i>Lyngbya confervoides</i>	*	**	*							
<i>Microcoleus chthonoplastes</i>	*	**	*	*	+	+	+			
<i>Xenococcus acervatus</i>					++	*	+		*	*

\* according to Lambert *et al.* 1989; + Inhaca Island; A, *Avicennia marina*; B, *Bruguiera gymnorhiza*; Bo, *Bostrychia* spp.; C, *Caloglossa* sp.; E, *Enteromorpha* sp.; G, *Gelidium* sp.; M, mud; Mu, *Murrayella* sp.; R, *Rhizophora mucronata*; Rh, *Rhizoclonium* sp.

*Lyngbya confervoides*, *Microcoleus chthonoplastes* and *Xenococcus acervatus*. Substrata upon which these common species were found show some similarity in both regions (Table 3). This flora consists mainly of non-heterocystous forms (88,2%), which compares well with the number found in southern Africa (85,2%; according to Lambert *et al.* 1989).

The results obtained in this survey show the diversity of species of Cyanophyceae associated with *Avicennia marina* and *Ceriops tagal* in mangroves at Inhaca Island, as follows: seven species of Chroococcales (one Microcystaceae, two Chroococcaceae, two Chamaesiphonaceae, one Hydrococcaceae and one Xenococcaceae), six species of Oscillatoriales (four Oscillatoriaceae and two Phormidiaceae) and three species of Nostocales (one Nostocaceae and two Rivulariaceae).

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# Notes on African plants

## VARIOUS AUTHORS

### LILIACEAE (ASPHODELACEAE)

#### THE TYPE SPECIMEN OF *ALOE SOUTPANSBERGENSIS*

Verdoorn (1961) cited the type specimen of her new species *Aloe soutpansbergensis* in the protologue as *Crundall s.n. in PRE 29005*. A diligent search, undertaken in the National Herbarium, Pretoria, in connection with our revision of the southern African species of *Aloe*, failed to reveal a specimen with this number.

A specimen, *Crundall s.n. in PRE 27035*, was found among the sheets of *A. soutpansbergensis*, however. It was collected in 1942, the year in which Verdoorn stated that her species was discovered, and was marked 'Figured for *Flowering Plants of South Africa*'. One would expect this



FIGURE 1.—The earliest specimen of *Aloe soutpansbergensis* Verdoorn. Evidence is presented in this paper for regarding this specimen as the type.



FIGURE 2.—The plate of *Aloe soutpansbergensis* Verdoorn published in the protologue.

annotation on the missing specimen, as the protologue was published in that journal and, of course, included a coloured illustration. Furthermore, the position of the leaves and flowers on the specimen (Figure 1) closely matches the published plate (Figure 2). Is it possible that by some error the specimen on which the plate was based, was registered twice, but the second number was not attached to the specimen?

The PRE register suggests that this was indeed the case, as the same details are recorded under both no. 27035 and 29005. Complicating the issue is another Crundall specimen of the same species from the same place, registered as no. 37735. This, however, was not figured and seems to be somewhat later than the other two.

We believe that the original painting of the plant holds the key to this puzzle. The outer cover bears the expected