Arab Gulf J. scient. Res. **4** (1), pp. 69-75 (1986)

A Peculiar Algal-Moss Association from El-Giza, Egypt

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ABSTRACT. Thin calcite moulds are formed around the upper parts of the sporophytes of the moss *Funaria hygrometrica* Hedw. due to association with filaments of the blue-green alga *Lyngbya sordida* (Zanardini) Gomont. Copious amounts of the filaments surround the upper part of the seta, capsule and calyptra. These moulds are comparable to tufa formation.

Mosses and algae form associations with various plants and animals (see for example: Abdin 1954, Bold 1973, Chiba and Kato 1969, El-Saadawi 1976, Gerson 1969, Millbank 1975, Rabtin 1980 Reese 1981, Rhoades 1981, Riedl 1977, Spiess and Lippincott 1978). It is beyond the scope of this paper, however, to go into details concerning the mode of association between the two partners in each case. It is sufficient to say that the relationships are variable. They may be beneficial to one partner but harmful to the other, beneficial to one partner but neutral to the other, or symbiotic. It must be mentioned, however, that little is known about the exact relationship between the two partners in many of these associations (see Darwish 1984).

Since algal-moss associations are rarely recorded in the literature (see El-Saadawi and Abou-El-Kheir 1973, Richardson 1981) it is the purpose of this paper to describe a peculiar algal-moss association observed during an excursion from the Botany Department of Ain Shams University for the collection of algae and mosses growing together in their natural habitats.

Material and Methods

The material consisted of one sample, including about 15 specimens, of a

fruiting moss in which the tops of individual sporophytes were covered by a dark-blue coloured filamentous growth having the appearance, as it was first seen in the field, of a fungal mould. The sample was collected on 11.6.1979 from the surface of a wet wall under the edge of a bridge built over the Maryotiya irrigation canal where it crosses the main road to the pyramids of El-Giza. The collected sample does not represent a widespread phenomenon but a single peculiarity that was not found in other sites. Unfortunately, on a second visit to the Maryotiya site a few weeks later (on 6.7.1979), for the collection of more specimens, it was found that the site had been completely destroyed by road works.

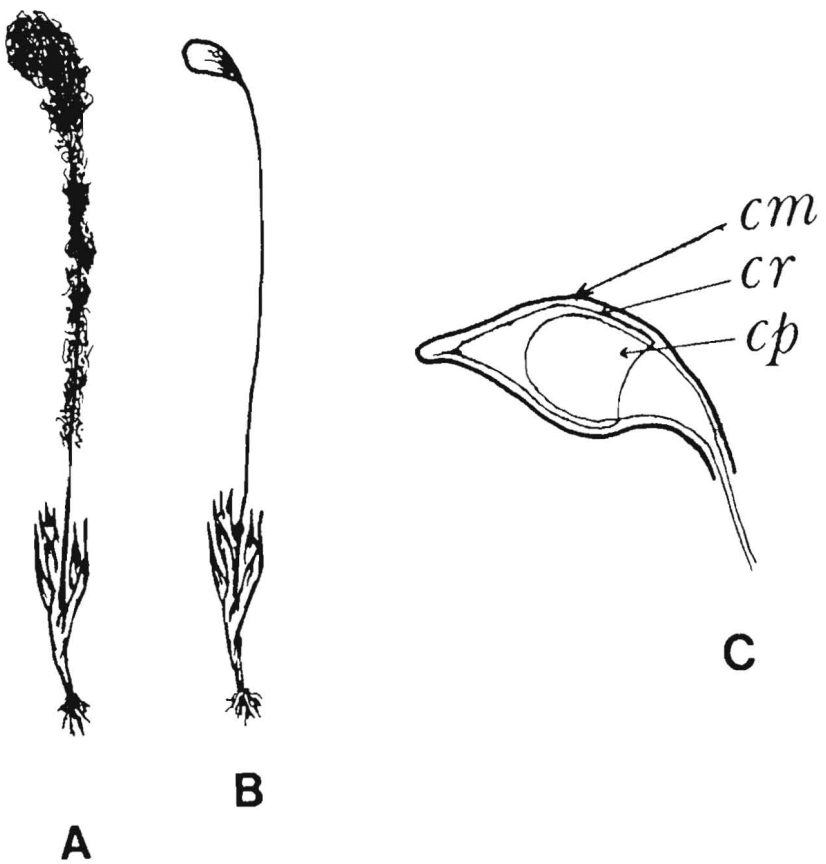
One portion of the sample was kept dry in a paper packet while the other was preserved in a mixture of formalin-acetic-acid (Johnsen 1940) after gentle cleaning with water. The sample was deposited in the Herbarium of the Botany Department, Faculty of Science, Ain Shams University (under serial number 39).

The organisms have been determined as the moss *Funaria hygrometrica* Hedw. (See Bartram 1949, Nyholm 1975, Smith 1980) and the blue-green alga *Lyngbya sordida* (Zanardini) Gomont (see Desikachary 1959, Geitler 1959). *L. sordida* is quite distinct from *L. epiphytica* Hier. in filament size and cell shape (Desikachary 1959, Geitler 1959).

Owing to the small number of specimens collected and the fact that many of them have been destroyed during investigation only a very small amount of the incrustation, found between the moss and the alga, was available for determination of its chemical structure. Chemical analysis proved it to be calcium carbonate. Calcium was identified by a test with sodium rhodizonate and sodium hydroxide, a method described by Fiegl (1958) for inorganic microanalysis. The carbonate was identified by test with dilute HCl. Furthermore, the presence of calcium was confirmed by test with oxalic acid. Examination by polarizing microscope showed that it is a carbonate mineral and that it is most probably calcite owing to the twinkling property in the plane polarized light (see Dapples 1967).

Description

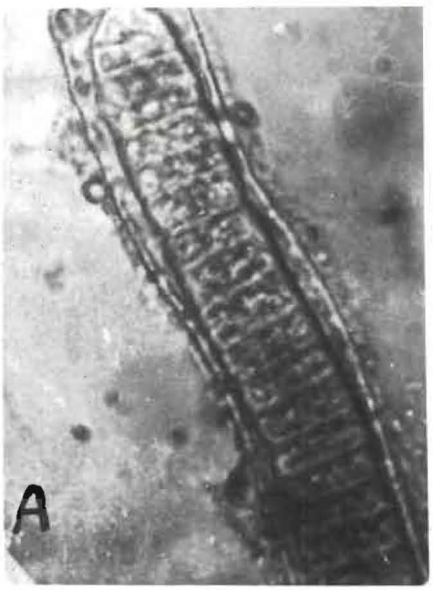
The filaments of the alga (Plate IA) were wound around the upper part of the seta, capsule and calyptra of the moss sporophyte (Text-Fig. IA and Plate IB, C). Careful removal of the algal filaments revealed the presence of a whitish, thin rigid mould of calcite surrounding the upper part of the moss sporophyte and occurring between it and the algal filaments (Text-Fig. IC). Careful removal of the calcite mould also removed the calyptra (Text-Fig. IB), which was stuck to the inner face of the mould. The moss plants both gametophytes and sporophytes, however, looked healthy and were apparently not adversely affected by the algal filaments. The sporophytes were almost mature.

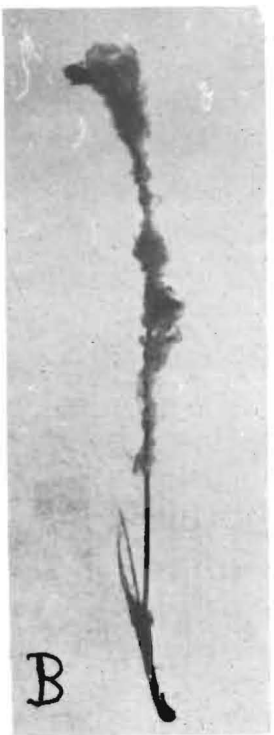


Text-Fig. 1. A— *Lyngbya sordida* surrounding the upper part of a *Funaria* plant. X 4.

B— *Funaria* plant cleared of the alga, calcite mould, and calyptra. X 4.

C— Calcite mould (= cm) covering calyptra (= cr) and capsule (= cp): diagrammatic drawing after removal of the algal filaments.





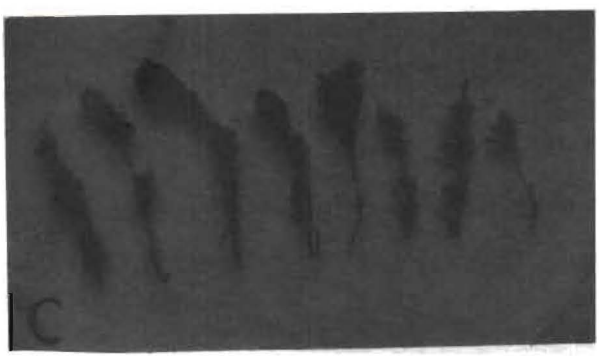


Plate I

Fig. A. *Lyngbya sordida:* portion of a filament. X 960.

Fig. B. Filaments of *L. sordida* surrounding the upper part of the sporophyte of *Funaria hygrometrica*. This specimen was photographed after being kept in fixative for 8 months and after removal of the calcite mould and calyptra. X 4.

Fig. C. Several specimens of *F. hygrometrica* with sporophytes covered with copious amounts of *L. sordida* filaments. X 1.3.

Discussion

Lyngbya sordida grows on the Atlantic and Mediterranean coasts (Geitler 1959). It is known to be epiphytic on other algae and seagrasses (Humm and Wicks 1980). However, there is nothing described in the literature similar to the peculiar calcite mould formed around the upper parts of the sporophytes of *Funaria hygrometrica* when surrounded by compact filaments of the epiphytic alga. The nearest similarity lies in the formation of tufa. This is formed (Parihar and Pant 1975) "when a spongy growth of mosses and algae provides surfaces which can absorb, retain and expose copious thin films of calcium bicarbonate-containing water for effective evaporation with the consequent loss of carbon dioxide and precipitation of calcium carbonate in the form of calcite which hardens around the mosses taking a mould of their form; thus forming the tufa. The lower portions of the moss cushion become progressively cemented while growth at the apex of the moss shoots proceeds resulting in a steady increase in the thickness of the tufa. The tufa later hardens and turns brown forming the travertine".

The present specimens of *Funaria,* covered with rigid calcite moulds, were collected in the hot summer season when the evaporation rate is high and conditions are thus favourable for the loss of carbon dioxide and the precipitation of calcium carbonate. However, in the present example the mould is formed around the upper part of the moss (not the lower as in case of tufa) thus probably prohibiting further growth of the capsule but not the gametophyte. This may explain why the sporophytes also were healthy and apparently not affected, as they are gonotrophic.

Acknowledgement

Thanks are due to Dr. Fathi El-Shah'haat (Prof. of Chemistry, Ain Shams University) for kind help with the chemical analysis of the mould and to Dr. Hafez Shams El-Din (Geology Dept., Ain Shams University) for kind help with the polarizing microscope.

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(Received 15/03/1985;
in revised form 28/05/1985)

ترابط مميز بين طحلب وحزاز بمنطقة الجيزة بمصر

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يتكون قالب خارجي رقيق من الكالسيت (كربونات الكالسيوم المتبلورة) حول الجزء العلوي من الجيل البوغي (الجرثومي) لحزز *Funaria hygrometrica Hedw.* بسبب نموه برفقة خيوط الطحلب الأزرق المخضر. .

Lyngbya sordida (Zanardini) Gomont. حيث تلتف كميات غزيرة من هذه الخيوط حول الجزء العلوي من الحامل والصماد والكاليبترا، ويمكن مقارنة هذه القوالب الخارجية بالحجر المسامي (التوفة).