

Lower Carboniferous plants from Abu-Thora Formation in Southwest Sinai

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Impressions of stem fragments of Lepidodendrales are described from Lower Carboniferous strata from Abu-Thora Formation in Southwest Sinai .

Key words: Abu-Thora Formation, Egypt, Lepidodendrales, Lower Carboniferous, Sinai.

Introduction

Numerous works have been published concerning Carboniferous plants from Egypt. Up till now, one-hundred and two species have been reported from this age: (4 from Devonian-Carboniferous, 92 from Lower Carboniferous and 6 from Upper Carboniferous) [cf.Seward ,1907& 1932; Kräusel 1939; Jongmans & Koopmans 1940; Jongmans & Van der Heide 1953& 1955; Horowitz 1973; Barakat, et. al. 1984; Klitzsch & Lejal-Nicol 1984; Lejal-Nicol 1987& 1990; Darwish 1990; Yousef , 1993] .The majority (99 species) of the reported fossils belong to pteridophytes while a small minority (3 species) belongs to gymnosperms. Localities from which these Carboniferous plants were collected in Egypt are shown on a map in Figure (1) .Half of these localities lie in southern Sinai where also half the number of species (51 out of 102) have been reported .All species reported from Sinai were pteridophytes.

The aim of this paper is the furtherance of our knowledge about the Carboniferous plants of southern Sinai, for which reason fossil specimens were collected from Abu Thora Formation in Wadi Abu Thora (Figure 2).

Lithostratigraphy

The Palaeozoic rocks exposed in southwestern Sinai have been subdivided into four rock units (El Kelani *et al.*, 1999). These include from base to top; Araba, Um Bogma, Abu Thora and Abu Durba formations. The lower Araba Formation is dominantly clastics and belongs to the Cambrian. Um Bogma, Abu Thora and Abu Durba formations represent the Carboniferous sediments.

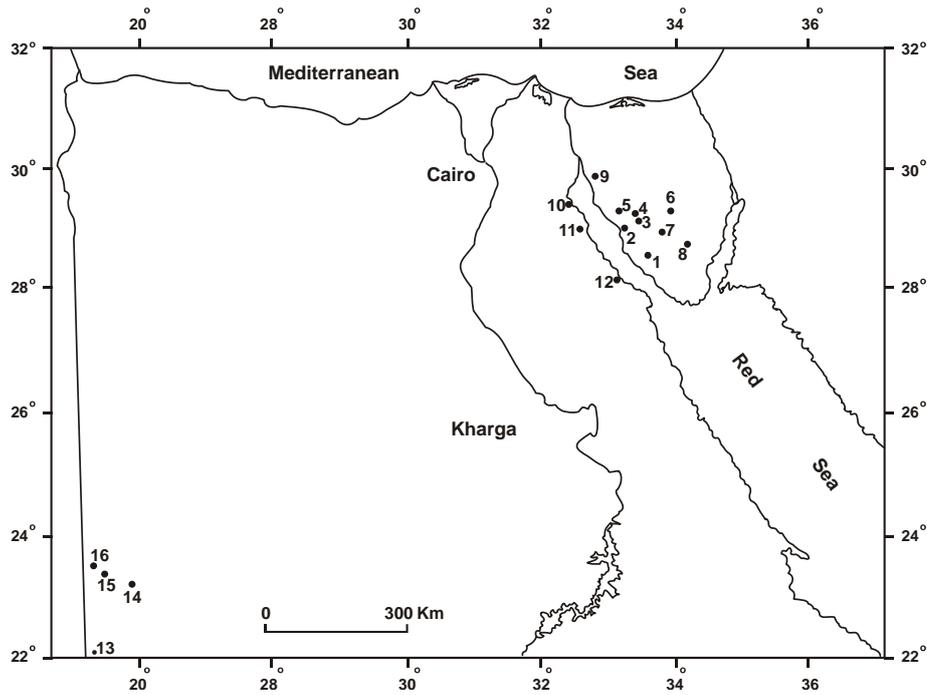


Fig. 1. General Map of Egypt showing sites of Carboniferous age mentioned in the text **1-** Wadi Mukattab. **2-** Abu Zenima. **3-** Um Bogma. **4-** Wadi Khaboba **5-**Wadi El-Hommur. **6-**Plateau El-Tih. **7-** Abu Thora. **8-**Magharet El-Maiah. **9-**Ayun Musa **10-** Abu Darag. **11-**Wadi Araba. **12-** Ras Gharib. **13-** Gebel Uwinat. **14-**Gilf Kebir. **15-**Abu Ras. **16-** Wadi Abd El-Malik.

The Abu Thora Formation is of Early Carboniferous (Visean) age (Table 1) and is underlain by the Lower Carboniferous Um Bogma Formation and overlain by the Upper Carboniferous Abu Durba Formation.

Table (1) : Division of geological time (Late Palaeozoic) .

Time (m. years)	Era		Period	Epoch	Age
215-			Permian		
335-	Late Palaeozoic	Carboniferous	Pennsylvanian	Late	Stephanian
					Westphalian
					Namurian
			Mississippian	Early	Visean
			Devonian		Tournaisian

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The Abu Thora Formation (Weissbrod, 1980) is well developed and best exposed at Wadi Abu Thora, Um Bogma, Wadi El Mukattab and Wadi El Shallal (Fig.2). The upper part of the section contains fossil plants (Fig. 3) .

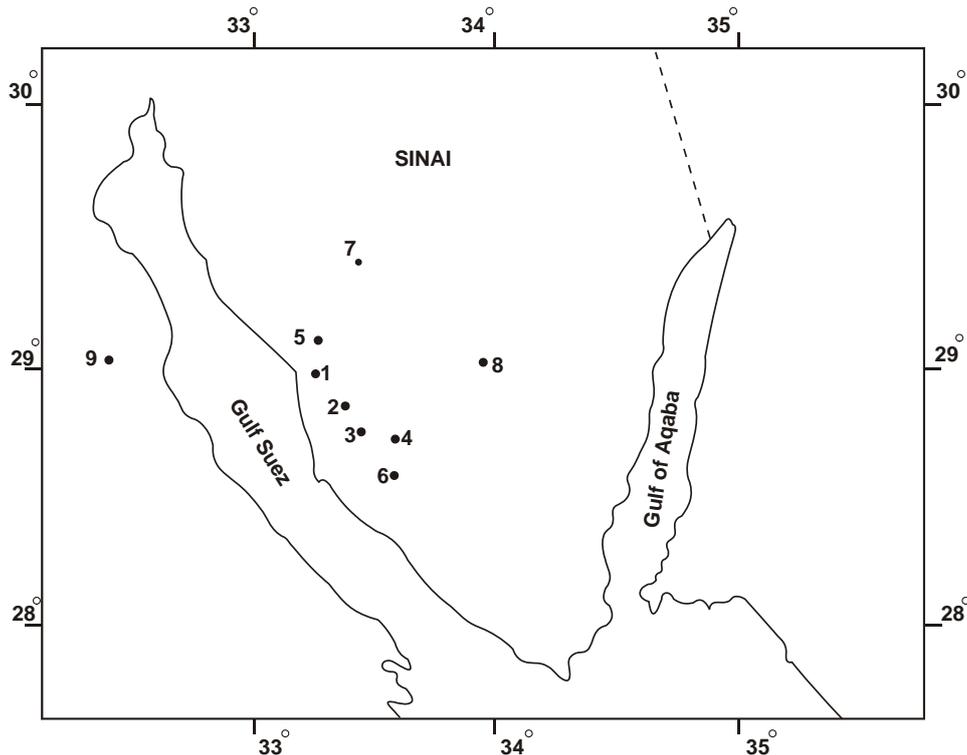


Fig. (2). Location Map of the Study Area and some neighbouring sites. 1-Um Bogma. 2- W.Budra. 3- W.Mukattab. 4-W. Shallal. 5-W.El-Hommur. 6-W.Feiran.7- W.Abu Thora. 8- G. Raqaba. 9-W. Arab.

The Abu Thora Formation measured ca 242 m at Wadi Abu Thora (the type section), 102 m at Wadi Mukattab, 60 m at Wadi Feiran and 66 m at Wadi Araba (Fig. 2) (El Kelani *et al.*, 1999). Lithologically, the Abu Thora Formation is a light coloured sandstone with subordinate claystone, green to grey shale; carbonaceous shale, coal seams and siltstones are the most abundant lithotypes. They are mostly light in colour and in places are fine to medium grained, well sorted, rounded to subrounded cemented by argillaceous matrix, sometimes iron oxides and carbonate cements are common (Fig.3). The sandstones in the upper part are friable fine grained, white quartz arenite. Shales are varicoloured from green to grey and black, fissile with plant remains. Thin coal seams and sulfur pockets were recorded through the shale beds especially in the middle part of the sequence. Siltstones are dark grey at upper part of the Abu Thora Formation and these are exploited commercially in Wadi Natash area.

The sequence of Abu Thora Formation is intruded by basalt and dolerite dykes and sills in Um Bogma area and at Wadi Budra (El Kelani *et al.*, 1999) (Fig.2) .

The Abu Thora Formation exhibits several primary structures. Cross beddings are mainly trough and wedge types and in part tabular. Ripple marks are quite prominent. The longitudinal and lingoid ripple marks have ripple indices of about 2, while the longitudinal ripple indices range between 2 and 7 which means aqueous type. Both types are characterized by the abundance of rip and furrows i.e. the zones showing these ripple marks indicate that the area was under water conditions with waves and currents initiating these ripple marks (El Kelani *et al.*, 1999).

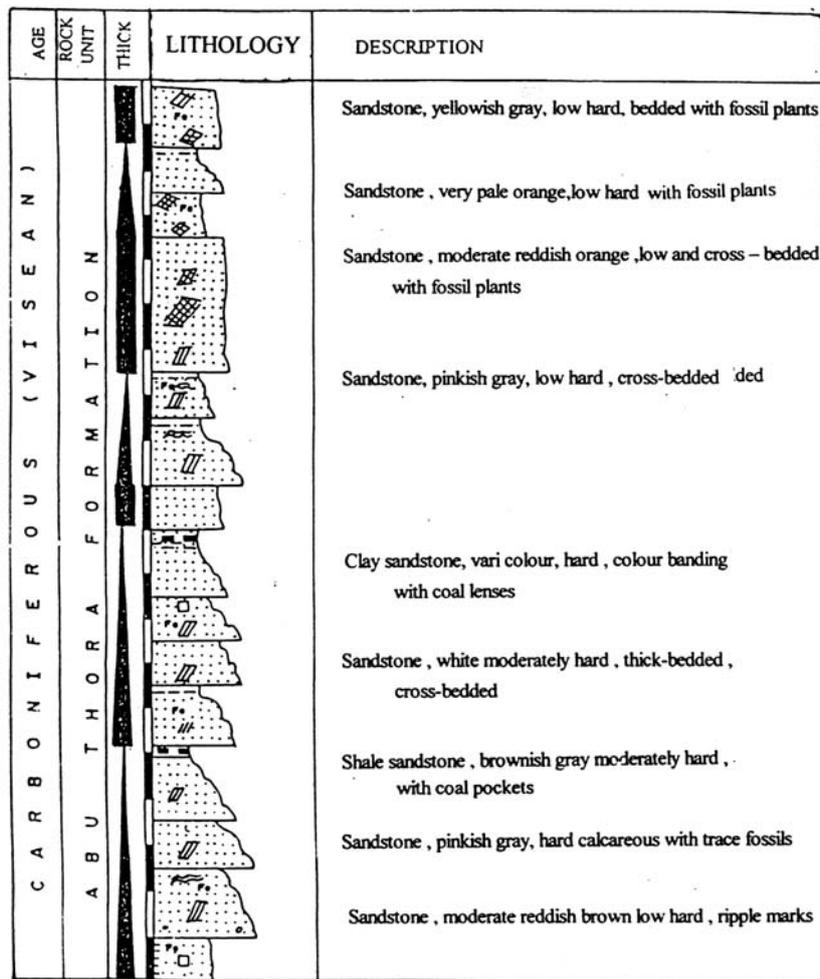
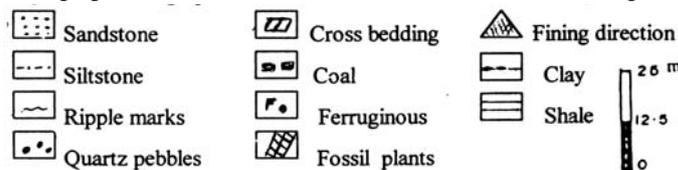


Fig. 3. Lithostratigraphic Succession of Abu Thora Formation in Um Bogma area.



Plant Fossils

Five specimens containing plant remains were collected from the upper part of Abu Thora Formation at Wadi Abu Thora. All plant remains are in the form of impressions with no organic matter left. The rock matrix and impressions have the same colour; they are brown-red to slightly dark at parts.

The fossils are remains of arborescent pteridophytes. They are all stem impressions. They represent the following five species. All belong to Class Lycopside as comes below:

Division: Pteridophyta.

Class: Lycopside

Order: Lepidodendrales

Genus: *Lepidodendropsis* Lutz 1933.

Lepidodendropsis hirmeri Lutz 1933 (Fig. 4 a)

Lepidodendropsis schuermanni Jongmans 1955 (Fig. 4 b)

Genus: *Lepidofloyos* Sternberg 1825.

Lepidofloyos laricinum (*Lepidophloios*) Sternberg 1825 (Fig. 4 c)

Genus: *Heleniella* Zalessky, 1930.

Heleniella costulata Lejal 1968 (Fig. 4 d)

Genus: *Lepidodendron* Sternberg 1820

Lepidodendron veltheimii Sternberg 1825 (Fig. 4 e)

Floristic Comparisons and Discussion

The present five species have been described earlier from Egypt: *Lepidodendropsis hirmeri* from W. Abd El -Malik, Abu Ras Plateau and Gilf Kebir; *Lepidodendropsis schuermanni* from Um Bogma, Ras Gharib and Ayun Musa; *Lepidofloyos laricinum* from Wadi Mukattab; *Heleniella costulata* from W. Abd El -Malik and *Lepidodendron veltheimii* from Um Bogma, W. Dakhal (Suez Area) and W. Abd El-Malik (cf. Klitzsch & Lejal-Nicol, 1984; Lejal-Nicol, 1987).

This means that *Lepidodendropsis hirmeri* and *Heleniella costulata* are new records to Sinai while all five reported species are new records to Wadi Abu Thora locality.

The Abu Thora plant association is similar to the flora found in the Visean strata of south-west Egypt (sites no. 13-16 in Fig. 1) and northern Sudan except for *Lepidofloyos laricinum* which is so far reported only from Sinai.

Lepidodendropsis hirmeri of Abu Thora is slightly longer than *Lepidodendropsis hirmeri* reported from Gilf kebir and Wadi Malik (cf. Klitzsch & Lejal-Nicol, 1984; Lejal-Nicol, 1987) and *Lepidodendropsis schuermanni* is similar to that described by Lejal-Nicol (1987) from Um Bogma. *Lepidofloyos laricinum* of Abu Thora is similar to that described by Kvacék and Strakova (1997) from Carboniferous of Bohemia, and smaller in size than that of Wadi Mukattab (described by Lejal-Nicol 1987). *Heleniella costulata* of Abu Thora is smaller in size than that recorded by Lejal-Nicol (1987) from Upper Tournaisian of Wadi Malik.

Lepidodendron veltheimii of Abu Thora is similar to that described by Lejal-Nicol (1987) from Wadi Dakhal with slight differences in dimensions.

Lepidodendropsis is represented in Sinai by 9 species out of 14 species from Egypt; *Lepidofloyos* is represented in Egypt by 2 species from Sinai; *Heleniella* is represented in Egypt by one species only from W.Abd El -Malik and *Lepidodendron* is represented in Sinai by 6 species out of 8 species from Egypt.

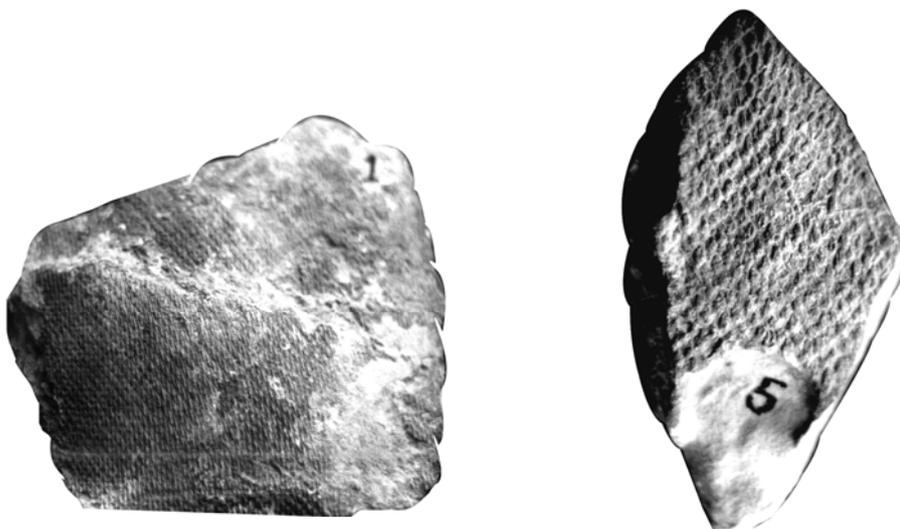
The flora described here is similar to the flora found in the Lower Carboniferous from other localities in Africa, for example at the Djado Basin in Niger (Lejal-Nicol, 1968) and similar to the Carboniferous (Mississippian) flora of Spain, Donetz basin, United States, Libya, China and Peru.

Lejal-Nicol (1987) noticed that in the Devonian and in the Early Carboniferous period, the palaeoflora (Lycophyta and Pteridophylla) from Libya, Niger and Egypt mainly show similarities with those of South America, India, Australia and China.

The Devonian and Early Carboniferous fossil floras indicate a generally warm climate (Lejal-Nicol, 1990). Lejal-Nicol (1987) mentioned that from the Upper Devonian to Upper Tournaisian of Egypt, Protolipedendrales and Lepidodendroid (*Lepidodendropsis*) forms are found. These plants were adapted to a dry and warm climate. At Visean time, the flora became more diversified.

Lycophyta dominated land plants and Lepidodendrales appeared (*Eskdalia*, *Lepidodendron*). The climate was warm and according to the degree of wetness, several plant strata can be distinguished. In the Namurian *Lepidodendropsis*, and *Pseudolepidodendropsis* disappeared; *Lepidophloios* flourished, and the climate was very wet and swamp forests were more developed.

From the plants and the different primary structures, the authors assume a fluvial to aeolian environment.



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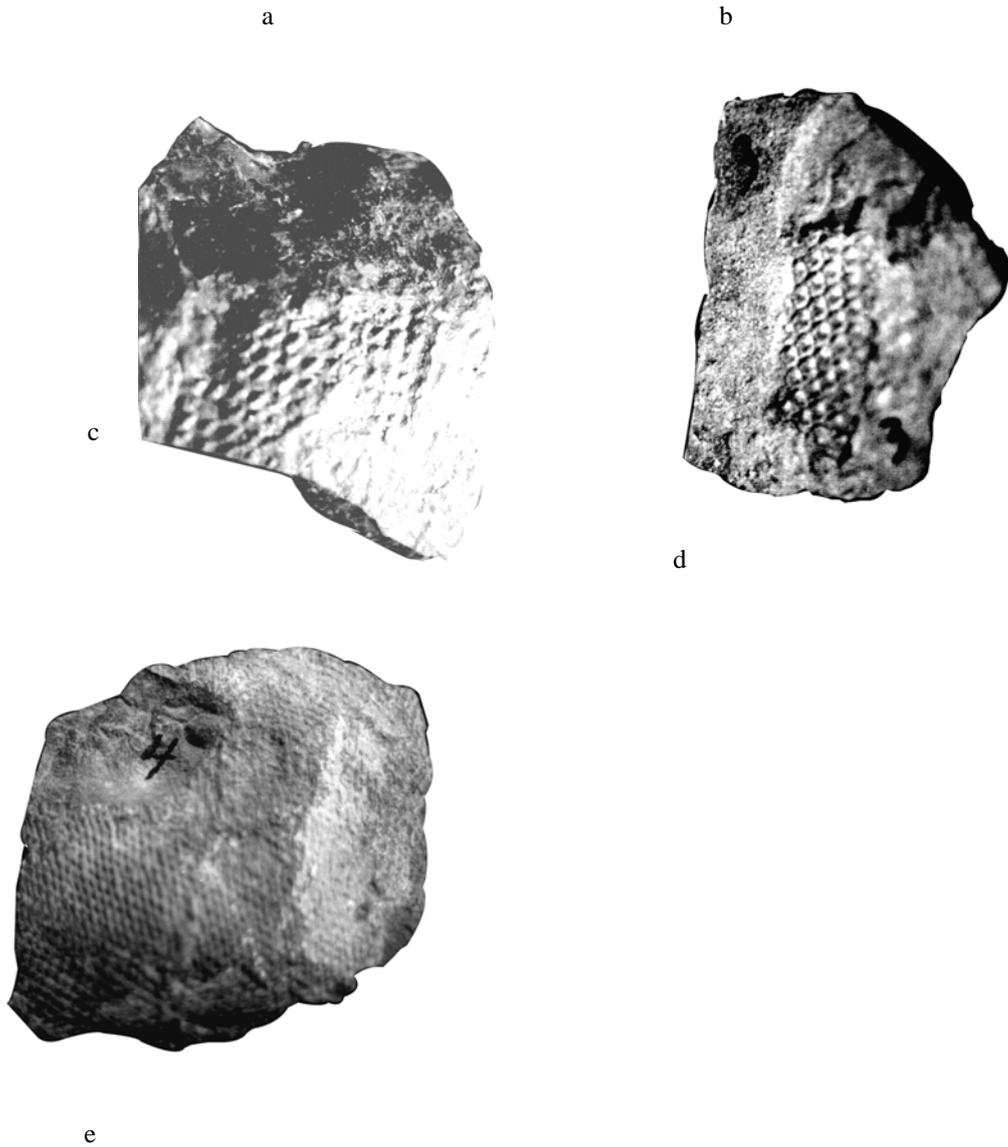


Fig. 4. Impressions of stem fragments of :

- a. *Lepidodendropsis hirmeri* (x 0.2),
- b. *Lepidodendropsis schuermanni* (x 0.4),
- c. *Lepidofloyos laricinum* (x 0.2),
- d. *Heleniella costulata* (x 0.3),
- e. *Lepidodendron veltheimii* (x 0.4).

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