

COMPARISON OF FRUITS AND SEEDS OF FOSSIL SPIREMATOSPERMUM (ZINGIBERACEAE) WITH THOSE OF LIVING CENOLOPHON

A preliminary report from the Phytopaleontological Section,
Geological Institute, Aarhus University

WALTER L. FRIEDRICH AND B. ESKE KOCH

FRIEDRICH, W. L. & KOCH, B. E.: Comparison of fruits and seeds of fossil *Spirematospermum* (Zingiberaceae) with those of living *Cenolophon*. *Bull. geol. Soc. Denmark*, vol. 20, pp. 192-195. Copenhagen, November, 12th, 1970.

Well-preserved fruits of *Spirematospermum wetzleri* (Heer) Chandler from a new Miocene locality in Jutland, Denmark, are trilocular and have axile placentation. This is in contradiction to previous opinions. The fruits are in morphology and anatomy quite similar to those of the living species *Cenolophon oxymitrum* (Schum.) Holttum from Thailand. The seeds of the living species show spiral striation on the testa which is well-known from the fossil ones.

Fruits and seeds of *Spirematospermum wetzleri* (Heer) Chandler are frequently found in Tertiary deposits of Eurasia. About 100 localities with these very characteristic plant remains are known. Its fruits and seeds were first described from Germany by Heer (1859, p. 192) as *Gardenia wetzleri*; Ludwig (1860, p. 124) referred it to *Passiflora* and Menzel (1914, p. 13) found that it probably could be a monocotyledoneous plant. Chandler (1925, p. 19) examined seeds of relevant families and found only in the family *Zingiberaceae* a structure similar to this peculiar seedtype.

In view of the distinctive characteristic of this fossil and the frequency with which it had been recorded, Chandler (1925, p. 20) gave it a provisional generic name and called it *Spirematospermum wetzleri*.

Previous authors (Heer, 1859, Ludwig, 1860, Menzel, 1914) interpreted the fruits to be unilocular with parietal placentation. Kirchheimer (1936), who studied the material from Salzhausen in Germany, came to the same conclusion. Chandler (1925, p. 19) found in the recent genus *Globba* – the fruits of which are unilocular with parietal placentation – anatropous seeds with subapical chalaza, having a funnel-shaped hilum with a small plug similar to the fossil seeds of *Spirematospermum*. *Globba* was therefore accepted by many authors to be a recent relative of *Spirematospermum wetzleri* (Heer) Chandler.

In a locality recently discovered (Koch & Friedrich, 1970) in the Miocene browncoal-deposits in Jutland, Denmark, the authors found about 70 well-preserved fruits of *Spirematospermum wetzleri* (Heer) Chandler and several hundred seeds of it. This is the first record of this fossil from Denmark (fig. 1).

We were able to study the morphology and anatomy of the fruits in many thin sections and microtomepreparations and we have found that they are trilocular and *not unilocular* as previous believed (pl. 1, fig. 4).

Reexamination of some specimens originally described by Ludwig (1860), Menzel (1914) and Kirchheimer (1936) from Hessisches Landesmuseum (Darmstadt), Natur-Museum und Forschungs-Institut Senckenberg (Frankfurt) and Museum für Naturkunde (Berlin) clearly showed that these fruits also must have been trilocular, since remains of the septa were still visible.

The living genera of *Zingiberaceae* fall naturally into 2 groups: those with trilocular fruits and axile placentation (in most genera) and those with unilocular fruits and parietal placentation (the *Globba* group) (Holttum, 1950, p. 13).

Searching for comparative material of trilocular, elongated fruits of *Zingiberaceae* resembling those of *Spirematospermum*, we received from Prof. Holttum, Kew Gardens, and Prof. Kai Larsen, Aarhus, independently of each other, the advice that there was one species in the *Alpinia* group (sensu Holttum): *Cenolophon oxymitrum* (Schum.) Holttum. Prof. Kai Larsen kindly provided us with three fruiting inflorescences of this plant collected in Thailand by the Thai-Danish Expedition (Larsen, 1963).

On the basis of this new information a comparative study between fossil and recent fruits and seeds has been undertaken.

Fruits and seeds of *Cenolophon oxymitrum* (Schum.) Holttum show striking similarities to those of *Spirematospermum wetzleri* (pl. 1). The *Cenolophon* fruits are elongated, 5 cm long and max. 2 cm thick, longitudinally ribbed, trilocular, manyseeded, with 1 to 2 rows of seeds in each locule (pl. 1, fig. 3). The seeds are closely packed in the fruit, angled where they meet, with a rounded outer surface where they are in contact with the wall of the fruit, as observed in the members of the *Alpinia* group (Holttum, 1950) and the fossil *Spirematospermum wetzleri*. The seeds are anatropous, the chalaza is subapical and they are closed by a plug on the base. The aril and the tissue of the testa are spirally arranged, thus showing characteristic spiral striae as known from the fossil seeds of *Spirematospermum wetzleri* (pl. 1, fig. 1-2).

Both in *Spirematospermum* and *Cenolophon*, silica bodies are found in the cells of the inner cuticula of the testa. A detailed anatomical comparison between fossil and recent fruit and seed will be published later.

It is also an interesting fact that the similarities extend into the sociolo-

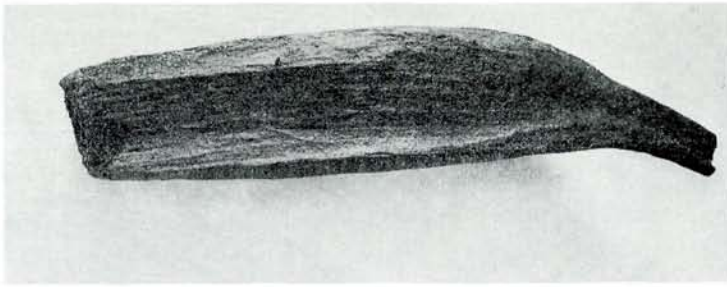


Fig. 1. Fruit of *Spirematospermum wetzleri* (Heer) Chandler (No. CN 3.22) from Fa-sterholt. $\times 1$. Phot. J. Sommer.

gical and environmental demands of the genera in question. Both *Cenolophon* and *Spirematospermum* are found accompanied by characteristic genera.

Cenolophon is known from Cambodia, Vietnam, Malaysia and Thailand, where it grows in evergreen forests at altitudes of 800–1000 m. In Thailand it commonly grows along watercourses together with ferns, laurels and others. In the same region also *Mastixia*, *Symplocos*, *Magnolia*, *Nyssa*, and *Tetrastigma* are observed (Larsen, pers. commun.), genera well known as paleotropical elements in Tertiary floras (Mai, 1967). These genera are often found together with *Spirematospermum wetzleri*.

Our investigation emphasizes the earlier opinion that *Spirematospermum wetzleri* (Heer) Chandler belongs to the *Zingiberaceae*. The trilocular structure of the fruit and the axile placentation excludes it from the *Globba*-group. The results of our preliminary investigation underline that *Cenolophon oxymitrum* (Schum.) Holtum is a quite close relative to the fossil *Spirematospermum wetzleri* (Heer) Chandler. It is the only living species of the *Zingiberaceae* which has elongated fruits of this particular size, and seeds with spirally striated testa. The latter character was for long time searched by paleobotanists.

Acknowledgements. The study was supported by grants from the Statens Naturvidenskabelige Forskningsråd and the Carlsbergfondet.

We thank Professor R. E. Holtum (Kew Gardens) and Professor K. Larsen (Aarhus) for stimulating discussions and advices.

During our work on *Spirematospermum*, one of us visited the following institutions and persons:

British Museum (N. History) London (Dr. K. I. M. Chesters)

Hessisches Landesmuseum, Darmstadt (Dr. Heil)

Natur-Museum und Forschungs-Institut Senckenberg, Frankfurt (Dr. F. Schaa-schmidt)

Museum für Naturkunde, Berlin (Dr. H. Jähnichen und Dr. L. Rüffle)

Zentrales Geologisches Institut, Berlin (Dr. D. H. Mai)

We wish to express our gratitude to the above mentioned persons and institutions.

Dansk sammendrag

Fossile frugter af *Spirematospermum wetzleri* (Heer) Chandler (fam. *Zingiberaceae*) i god bevaringstilstand er fundet i betydeligt antal i de miocæne brunkulsaflejringer ved Fasterholt, Jylland. Frugterne har 3-kamre og axilær placentering. Dette harmonerer ikke med den tidligere opfattelse, som f. eks. henfører arten til den 1-kamrede *Globba*-gruppe (Chandler).

Frugterne af *Spirematospermum wetzleri* står i morfologisk og anatomisk henseende nær frugterne af den nulevende *Cenolophon oxymitrum*. Denne art har snoede frø med spiralstribning på frøskallen og elongate frugter ligesom *Spirematospermum wetzleri*. Undersøgelsen underbygger *Spirematospermum wetzleri*'s placering i fam. *Zingiberaceae*.

Section of Paleobotany
Geological Institute
Aarhus University
Ole Worm Allé
DK-8000 Aarhus C, Denmark
May 19th 1970

References

- Chandler, M. E. J. 1925: The Upper Eocene Flora of Hordle, Hants. *Mon. Palaeont. Soc. London* **1**, 32 pp.
- Heer, O. 1859: *Flora Tertiaria Helvetiae* **III**, 377 pp. Wintherthur.
- Holtum, R. E. 1950: The Zingiberaceae of the Malay Peninsula. *Gardens' Bull. Singapore* **XIII** (I), 250 pp.
- Kirchheimer, F. 1936: Beiträge zur Kenntnis der Tertiärflora. Früchte und Samen aus dem Deutschen Tertiär. *Palaeontogr.* **82**, B: 73-141.
- Koch, E. B. & Friedrich, W. L. 1970: Geologisch-Paläobotanische Untersuchung der Miozänen Braunkohlen bei Fasterholt in Jütland, Dänemark. *Bull. geol. Soc. Denm.* **20**, 169-191.
- Larsen, K. 1963: Report of the third Thai-Danish Botanical Expedition. *Bull. nat. Hist. Soc. Siam* **20**, 215-226.
- Ludwig, R. 1860: Fossile Pflanzen aus der ältesten Abtheilung der Rheinisch-Wetterauer Tertiär-Formation. *Palaeontogr.* **VIII**, 37-154.
- Mai, D. H. 1967: Die Florenzonen, der Florenwechsel und die Vorstellungen über den Klimaablauf im Jungtertiär der Deutschen Demokratischen Republik. *Abh. zentr. geol. Inst.* **10**, 55-81.
- Menzel, P. 1914: Beiträge zur Flora der Niederrheinischen Braunkohlenformation. *Jb. preuss. geol. Landesanst.* **34**, 98 pp.

Plate 1

Cenolophon oxymitrum (Schum.) Holttum.

Fig. 1. Seed with spiral striae and aril (AR).

Fig. 3. Cross-section of 3-locular fruit.

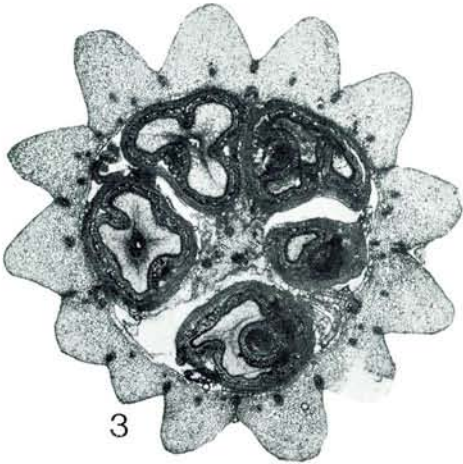
Spirematospermum wetzleri (Heer) Chandler.

Fig. 2. Seed with spiral striae.

Fig. 4. Cross-section of 3-locular fruit.



0.5 cm



1 cm