sporophyll in this species has the tendency to be originating from one, instead of two, adaxial end of □-like arrangement of vascular bundles, and to run spirally into the pith of the phyllomophore.

The writer also proposed "iso-marginal method" to replace the so-called marginal method, and attempted to establish three types of the methods, in the phyllomophore of the order Ophioglossales, iso-, hetero-, and extra-marginal, in order to express more precisely the character of the vascular branching.

**Literatures cited**


The Place of the Genus

*Phyllorachis* in the System of Gramineae*

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Received November 28, 1955

*Phyllorachis* represents a monotypic genus first described by Trimen in 1879. It's single species, *P. sagittata*, inhabits Angola, Portuguese East Africa and Tanganika Territory in Africa. Although it is considered to be one of the most interesting genera from the point of view of phylogeny, it has not been studied either karyologically or anatomically. A sample of seeds collected last year in Portuguese East Africa, Garuso, was kindly supplied by Dr. H. G. Schweickerdt, and germinated in our experimental garden. The present author was able to subject the plants to a karyological and morphological study. The results of his observations and some considerations on the relationships of this genus to the others are reported in this paper.

**Observations**

1. First leaf of the seedling

Audyulov (1931) pointed out that the first leaf of grass seedlings has a systema-
tic significance; he distinguished two maintypes: Type I, first leaf elliptic or lanceolate, and horizontal or ascendent; Type II, first leaf linear and perpendicular. The former type characterizes the members of Paniceae, Andropogoneae, Chlorideae, etc., and the latter is shared by the members of Festuceae, Hordeae, Aveneae, Phalariedae, etc. *Phyllorachis sagittata* belongs to Type I (Fig. 4).

2. Starch grains of the endosperm.

Hubbard (1939) mentioned that the starch grains in the endosperm of *Phyllorachis sagittata* were compound. This is in agreement with the present author’s observation (Fig.6) who previously (1954, 1955) reviewed the systematic significance of this character and found compound grains in a few members of Paniceae, although almost all representatives of this tribe showed simple starch grains. He concluded that further developmental investigations on starch formation were required. The compound grains of *Phyllorachis sagittata*, however, are typical, suggesting that referring *Phyllorachis* to the tribe Paniceae is a mistake.

3. Characteristics of epidermis and transverse sections of leaves.

The anatomical characteristics of grass leaves were studied and reviewed by
Avdulov (1931), Prat (1936), Potztal (1952), etc. They can be classified as follows.

Festucoid type—Chloroplasts are uniformly distributed throughout the mesophyll; epidermis lacks bicellular hairs and is characterized by siliceous cells that are round or rectangular. These characteristics are commonly found in members of typical festucoid genera.

Panicoid type—Chloroplasts are localized in a few cell layers surrounding directly the vascular bundles; epidermis includes dumb-bell-, cross-, or saddle-shaped siliceous cells and bicellular hairs. This type is divided into two following subtypes. Panicoid subtype, characterized by threadlike bicellular hairs and siliceous usually dumb-bell- or crossshaped cells, is found in members of Paniceae, Andropogoneae, Maydeae, etc. Chloridoid subtype shows thick clavate bicellular hairs and siliceous usually saddleshaped cells, and is found in the members of Chlorideae, Eragrosteae, etc.

Bambusoid type—Chloroplasts are uniformly distributed throughout the mesophyll, the cell layer surrounding directly the vascular bundles has a characteristic feature in that it lacks chloroplasts; epidermis has threadlike bi-(or several-) cellular hairs and siliceous cells similar to those of Panicoid type. Bambusoid type is represented by members of Bambuseae and considered to be the most primitive with respect to the anatomical characteristics of the leaf.

In the transverse sections of leaves of *Phyllorachis sagittata*, a cell layer surrounding directly the vascular bundles is almost devoid of chloroplasts; chloroplasts were uniformly distributed throughout the mesophyll, which consisted of sponge-like and palisade-like parenchyma (Fig.1). The epidermis has threadlike bicellular hairs and somewhat dumb-bell-shaped siliceous cells (Figs.2—3). According to the classification described above, *Phyllorachis sagittata* belongs to the Bambusoid type.


Root-tip cells of *Phyllorachis sagittata* show twenty-four small chromosomes* (Fig.5). This number suggests the basic chromosome number as 12 or 6; the meiotic behaviour was not observed. This finding seems to be very interesting concerning the phylogeny of *Phyllorachis*, since the basic chromosome number of 12 or 6 small chromosomes is found only in primitive grass groups such as Oryzeae, Arundineae, Bambuseae, etc.

Considerations

Bentham (1881) referred *Phyllorachis* to the tribe Paniceae. This view was followed by Hackel (1887), Chase (1911), Bews (1929), etc. However, Hackel (1.c.) himself remarked that the reference of this genus to Paniceae was doubtful. Hubbard (1939) expressed an opinion that this genus should constitute, together with

* Root tips were fixed with Nawashin's solution, embedded in paraffin and cut at 15 micra. Crystal violet was used for staining. The figure was drawn with the aid of an Abbe drawing apparatus.
Humbertochloa, having many similarities in common in gross morphology, an independent tribe, Phyllorachieae. His opinion was based on a study of external morphology and a few observations of anatomical characteristics of leaves and starch grains. Hubbard's opinion was shared by Pilger (1954) who placed Phyllorachieae under his Subfam. Festucoideae.

From the results of observations described above, the uncorrectness of placing Phyllorachis in Paniceae or Chlorideae may be clearly pointed out as follows; 1) almost all members of Paniceae or Chlorideae show polyploid chromosome numbers of basic 9 or 10, 2) members of Paniceae or Chlorideae have Panicoid type in the anatomical characteristics of leaf. These features which characterize almost all representatives of Paniceae or Chlorideae are not in agreement with those of Phyllorachis.

On the other hand, Phyllorachis differs as follows from the typical members of Festuciformes group in the characteristics described above: 1) members of Festuciformes group have large somatic chromosomes mostly showing polyploid numbers of basic 7, 2) the type of anatomical characteristics of leaf in Festuciformes group is usually festucoid, 3) the first leaf of the seedlings of Festuciformes group are linear and perpendicular. Phyllorachis never shows these characteristics.

Phyllorachis sagittata must be a relic, considering the characteristics described above as well as the features of gross morphology analyzed by Hubbard (1939). Therefore, Phyllorachis together with Humbertochloa definitely should be treated as an independent tribe. Hubbard (1.c) suggests the near relationship of Phyllorachieae with Oryzeae, based upon some characteristics of gross morphology and the nature of starch grains. Hubbard's suggestion is also supported by the karyological and anatomical characteristics reported in the present study. A large majority of Oryzeae show polyploid chromosome numbers of 12 as well as Phyllorachis and also resemble Phyllorachis in the anatomical leaf characteristics. Pilgar (1954) placed Phyllorachieae in the Subfam. Festucoideae, and treated Oryzeae as an independent subfamily, Oryzoideae. It seems desirable that more thorough studies are carried out before deciding whether Phyllorachis belongs to Oryzoideae or must be treated as a member of Festucoideae.

The author wishes to express his gratitude to Dr. H.G. Schweickerdt who kindly collected and supplied the seeds of Phyllorachis sagittata. The author's thanks are also due to Dr. Y. Takenaka and Dr. J. Ohwi who helped him in many ways.

Literature