New species of *Gleichenites* (Gleicheniaceae, Filicales) from the Upper Triassic of Argentina and Chile

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Two new and one undetermined species of *Gleichenites* are described from the Upper Triassic Canadon Largo Formation (El Tranquilo Group) from Santa Cruz Province, Argentina, the Upper Triassic La Ternera Formation, Copiapo Province, northern Chile, and the Upper Triassic Gomero-Talcamávida Member of the Concepcion area in southern Chile. These findings together with former ones of Argentina, Australia and eventually Antarctica, reinforce the idea of a possible austral origin of the family Gleicheniaceae, or at least part of it. All the Triassic and part of the Jurassic hitherto known species from the Gondwana realm are multisorate and thus belong to the primitive members of the family included in the subgenus *Diplopterygium* in Holttum's sense.

Key-words—Palaeobotany, Filicales, *Gleichenites*, Upper Triassic, Argentina, Chile.

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RESUME

Se describen tres nuevas formas de *Gleichenites* : una del Triasico superior de la Formacion Canadon Largo (Group El Tranquilo) de la provincia Santa Cruz, Argentina, otra del Triasico superior de la Formacion La Ternera, provincia Copiapo, norte de Chile y una indeterminada del Triasico superior del Miembro Gomero-Talcamavida del area de Concepcion en el sur de Chile.

Ademas se brinda una sintesis de los hallazgos de este genero y otros afines del Mesozoico bajo del Gondwana (Triasico y Jurasico de Argentina y Australia) y en base a que casi todas las especies pertencen al primitivo genero *Diplopterygium*, se analiza brevemente la posibilidad de un origen austral para la Familia Gleicheniaceae, o al menos de una parte de esta.

सारॉश

अर्जेन्टीना एवं चाइल के उपरि त्रिसंघी कल्प से *ग्लीकीनाइटिस* की नई जातियाँ

रफॅल हर्बस्ट

दक्षिणी चाइल में कन्सेप्सन क्षेत्र के उपरि त्रिसंघी गोमेरो-तल्कामाविदा सदस्य एवं उत्तरी चाइल में कोपिआपो प्रदेश में उपरि त्रिसंघी ला तर्नेरा शैल-समूह तथा अर्जेन्टीना में सान्ताक्रुज प्रदेश से उपरि त्रिसंघी कालीन कनाडन लार्गो शैल-समूह से *ग्लीकीनाइटिस* को दो नई जातियाँ और एक अनिश्चित जाति का वर्णन किया गया है। इस अध्ययन तथा अर्जेन्टीना, ऑस्ट्रेलिया और अन्टार्कटिका से पहले से विदित जातियों से प्रदर्शित होता है कि ग्लीकीनिएसी कुल का उद्भव ऑस्ट्रेलिया में हुआ था अथवा इसके किसी भाग पर ही हुआ है। गोंडवाना क्षेत्र से इस प्रजाति की सभी जातियाँ बहुबीजाणुधानी युक्त हैं तथा होल्टम के अनुसार इस कुल के आद्य सदस्यों से सम्बद्ध हैं।

IN an earlier paper, Herbst (1972) described a new species of *Gleichenites* (*G. potrerillensis*) emphasizing the importance of its finding in the Gondwana realm. This was so, because at that time-and even now-a-days most authors supported a holartic origin for this (and many other) family of ferns. The main argument here was the existence of a presumed ancestor—*Oligocarpia* Goeppert which was known from impressions of several species from the Carboniferous of North America and Asia, as well as spores from the same age, attributed to them (Abbott, 1954).

After that paper at least three species of *Gleichenites* based on fertile impressions were found

in the Triassic of South America (herein described) and one, also of Triassic age, from Australia (Herbst, 1974). Other two species were already known from the Middle Jurassic of Argentina (Herbst, 1962; Herbst & Anzotegui, 1968); and one more, unfortunately sterile from the Middle Jurassic of northern Chile was lately found (Herbst & Troncoso, in press). Furthermore, based on petrified specimens Millay and Taylor (1990) described *Antarctipteris* from the Triassic of Antarctica, which was doubtfully placed with the Gleicheniaceae. On the other hand, the genus *Chansitheca*, originally described from the Lower Permian of Shansi (China), which is considered by some authors (Bolkhovitina, 1968) as another possible ancestor -or in the line of-*Gleichenites*, was also found in South America, although with only one species, and as late as Upper Triassic (Herbst, 1963).

In a recent paper Crabtree (1988) proposed new generic name — *Gleicheniaceaphyllum* for sterile fronds with a general "gleicheniaceous" morphology, i.e., small, more or less pecopterid to cladophleboid pinnules, with typical open, fern venation. In his discussion he maintains that the genus *Gleichenites* Goeppert is invalid being based on a Palaeozoic foliage (a species of *Sphenopteris*) and also as Goeppert's species are not the members of the family. This being true was recognized by Seward (1926) who revalidated the name as clearly stated by Harris (1931). Therefore most authors have used *Gleichenia* or *Gleichenites* (the distinction of these two names being part of another discussion) for fertile fronds with a general resemblance with the fertile fossil and recent members of the family Gleicheniaceae; it is with this characterization that usage has imposed the generic name without further problems.

It has to be stated that Crabtree (1988) gave a generic diagnosis which includes most of the morphological characters by which *Gleichenites* is known, but he also states that "pinnules, small alternate, elliptic to deltoid to falcate, connected to one another along rachis by thin strip of laminar tissue". His type-species, *G. falcatum* does not show this character both in his text-figure 4 and figures 1-5 of plate 4, where the pinnules are clearly imbricated. It has also not been stated in his specific diagnosis. Thus, the usefulness and the validity of this proposal are somewhat doubtful.

This list of cited forms from the southern hemisphere is relevant to a discussion about the origin of the Family Gleicheniaceae. It is noteworthy that more and more Triassic and Jurassic species are found in this region, while the worldwide expansion of the genus is mostly from the Cretaceous Period. Triassic and Jurassic species are rare in the "north".

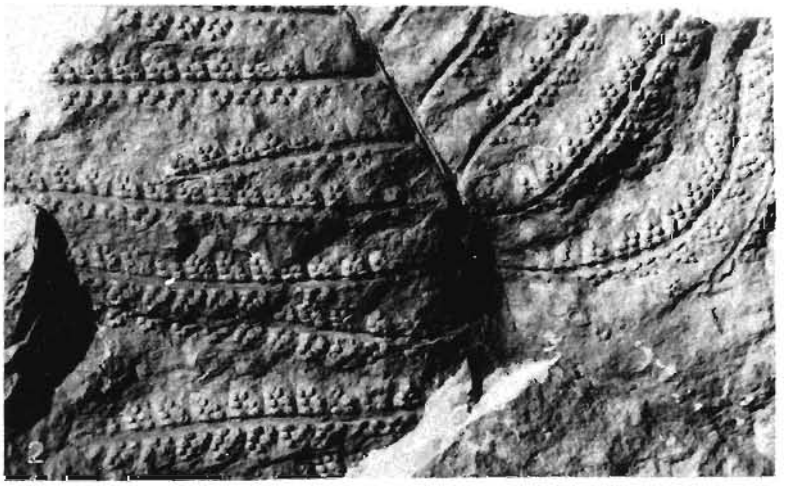
The taxonomy of the Gleicheniaceae is still a subject to debate; there are authors who accept only one genus *Gleichenia* (Holttum, 1957; Tryon & Tryon, 1982) with a subdivision in subgenera, to those for who raise these subgenera to generic level (Naiko, 1950; Pichi Sermolli, 1972), the latter author recognizes up to 8 genera. But all workers agree in considering *Diplopterygium* (no matter its taxonomic rank) as a primitive genus in the family and somewhat isolated from the rest.

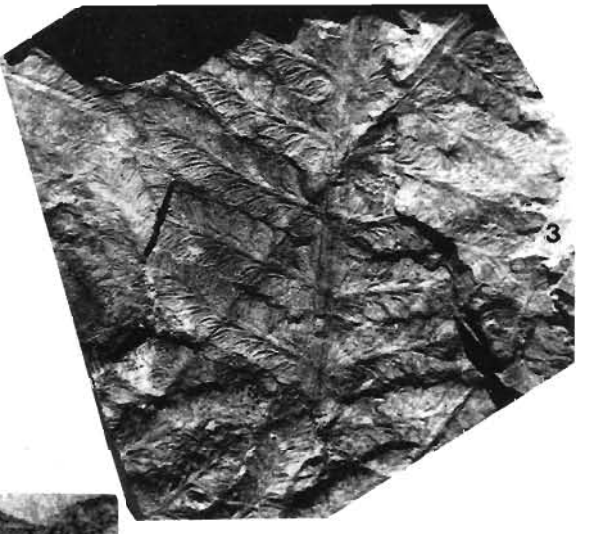
All the Triassic and most of the Jurassic species from the Gondwana land-masses are multisorate, and thus belong to this *Diplopterygium* Primitive "Group". But it is true that up to date no reliable possible ancestor from the Carboniferous or Permian has been found in the "south" while in the northern hemisphere some new forms are now and then proposed as ancestors; a recent example might be the genus *Szea* (Yao & Taylor, 1988).

Many modern authors when discussing phylogenetic relations and /or the origin of groups of plants (and animals as well) still somehow neglect the geographical data of the findings relaying more on evolutive trends or facts, and associate or relate organisms from very different geographical regions. Of course, it is always possible to invoque physical connections or migration routes to overcome this inconveniency but it is a fact, for this particular case, that from the Permian onwards and through most of the Triassic and Jurassic the Gondwana was almost completely disconnected from the other land masses.

PLATE 1

1, 6. *G. cachivartiensis*; 1, Sgo 1310 (Holotype), x 1; 6. CTES-PB 10129, x 2.
2, 3. *G. gallegoi*: 2, CTES-PB 10120,1,3; 3, Sgo 1307, x 1,3.
4, 5. *Gleichenites* sp.; 4, CTES-PB 10132, X 3; 5, CTES-PB 10131, X 3.





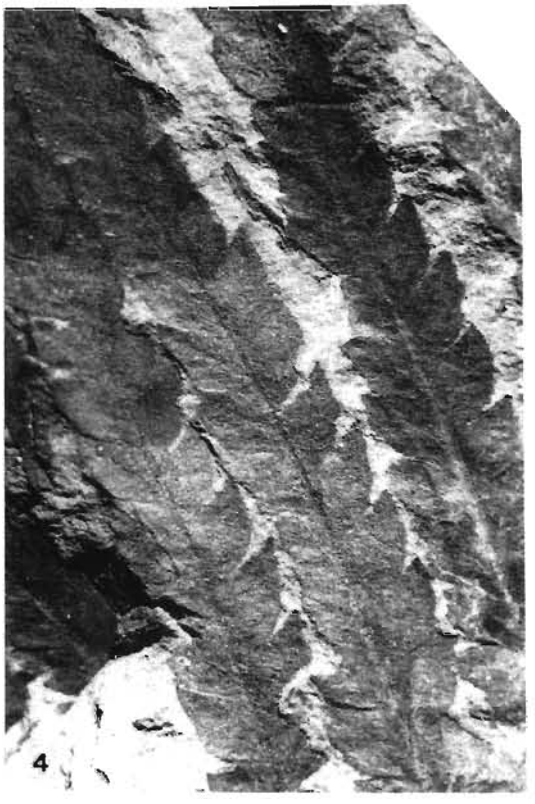
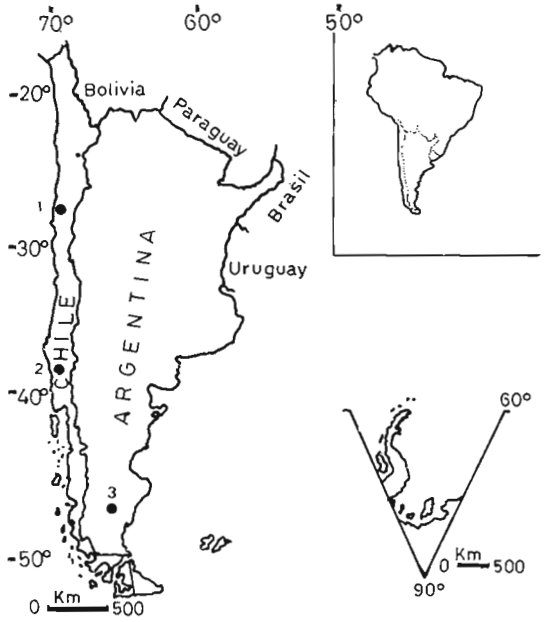
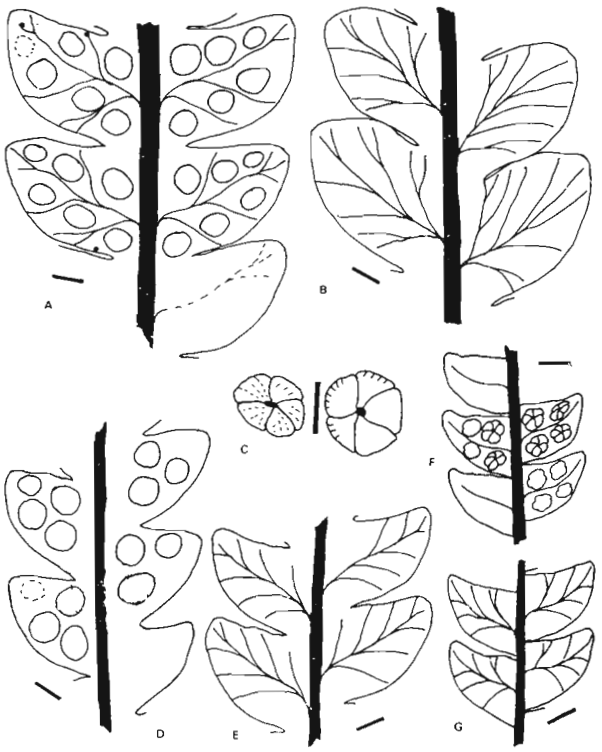


PLATE 1



Map 1 —Location map of outcrops with *Gleichenites*:
(1) area of Cº La Ternera, prov. Copiapó, Chile;
(2) area of Gomero, prov. Concepción, Chile, and
(3) area of El Tranquilo, prov. Santa Cruz, Argentina



Text-figure 1 — **A, B** and **C,** *Gleichenites pallegoi;* **D, E,** *Gleichenites* sp.; **F, G,** *Gleichenites cachivaritensis* (Bars are = 1 mm, except C where =0.5 mm)

Thus, the three species described in this paper are significant in favour of the above exposed ideas, which will have to be taken in account when the origin of the Gleicheniaceae or eventually a part of this family represented by the *Diplopterygium* group is established (Map 1). Naturally much more evidences will be necessary for this purpose.

SYSTEMATIC DESCRIPTION

Family —Gleicheniaceae

Genus —*Gleichenites* Seward 1926 (non Goeppert)

Gleichenites gallegoi n. sp.

Text-figure 1 A, B, C; Pl.1, figs 2-3

1988 *Gleichenites* sp. in Herbst : 376, pl.1, figs 7-10; pl. 4, figs 30-32.

Diagnosis —Fronds of unknown shape and size, at least bipinnate; main rachis 0.8-1 mm thick. Largest segment up to 8-9 cm long x 10 cm wide. Pinnae linear, up to 6 cm long x 7 mm wide, attached to the main rachis at 50°-60°, separated 6-8 mm. Pinnules cladophleboid, slighly falcate, united at the base; lower margin more curved than upper one, apex rounded. Size typically 5-6 mm long x 3-4 mm wide. Midvein strong, lateral ones simple and straight, 3-4 on each side, basal ones of each pinnule mostly once forked.

Fertile pinnules with six to seven sporangiate sori, the pentasporangiate being the most common. Number of sori in basal half of pinnule is generally higher than in upper half. Sori 0.7 to 1 mm in diameter with 4 to 7 sporangia (generally 5-6). Sporangia more or less pyriform, with a short peduncle (?); size about 0.4 mm high x 0.25-0.28 mm in diameter; in some impressions thick-walled cells can be seen apically but the disposition of the annulus is uncertain.

Holotype—CTES-PB no. 10120; Cotype no. 10121 (P1.1, figs 2 and 3 respectively).

Locality—Ea. Canadon Largo, Prov. Santa Cruz, Argentina.

Horizon—Canadon Largo Formation, El Tranquilo Group.

Age—Upper Triassic.

Discussion—In 1988, I wrongly described the sterile fragments of *Gleichenites* sp. as they were associated in the same slab with the fertile fragments (Herbst, 1988). The abundant and well preserved specimens now available show that these belong to *Cladophlebis* sp. while those of the new species have quite different shape and venation.

On the other hand I had already stated, based on the fertile specimens, that the species was not comparable to any known form from the Triassic or Jurassic of Australia, India and Argentina; this statement stands.

Gleichenites gallegoi is similar to *Gleichenites* sp. from Gomero (Chile) described in this paper but differs in the form of pinnae, pinnules and venation (Text-figure 1 A-C). However, more material from Gomero would show whether they are conspecific.

Gleichenites cachivaritensis n. sp.

Text-figure 1 F-G; Pl.1, figs 1, 6

Diagnosis—Fronds bipinnate of unknown size and shape; largest specimen 10 cm long x 12 cm wide. Main rachis 1-1.2 mm thick. Largest pinnae 6 cm long x 4- 4.5 mm wide, linear, attached at 80-90° and separated 4-5 mm. Pinnules pecopterid to cladophleboid, united at the base, lower margin more curved than upper one, apex rounded to somewhat acute at apical pinnae and pinnules. They are typically 2 x 2 mm long/wide. Midvein strong, with 2-3 simple lateral veins at each side; occasionally one or two veins are once forked near the margin.

Fertile pinnules 4-5 sporangiate (mostly 4-sporangiate), rounded sori, 0.7 mm in diameter. Basal sori of pinnules usually bigger than upper ones. Sporangia appear pyriform, sessile, with some of the cells from the annulus visible at the lateral apical region.

Holotype—SGO-PB no 1310 (P1. 1, fig. 1).

Locality—Quebrada de La Cachivarita, area of Co La Ternera, prov. Copiapo, IIIo, Region, Chile.

Horizon—La Ternera Formation.

Age—Upper Triassic.

Discussion—The present form looks different from all other species known from the Gondwana. Most of its characters, specially its small size separate it from them. The morphologically closest species could be *G. wivenhoensis* Herbst 1974 from the Triassic of Australia, but it distinctly differs in its soral characters.

Gleichenites sp.

Text-figure 1 D-E; Pl. 1, figs 4-5

Description—Fragments of a bipinnate frond of unknown size and shape. Segment rachis 1 mm wide. Pinnae linear, narrowing towards the apex, 1-5 cm long x 5-6 mm wide, attached to rachis at 40-45°, separated 7-8 mm. Pinnules cladophleboid, united at the base, sterile ones 4 x 3 long/wide, fertile ones 3.5 x 2.8-3 mm long/wide; lower margin slightly more curved than upper one, apex rounded, more acute in sterile pinnules. Midvein marked, lateral ones simple and straight, 2-3 on each side. Occasionally one of the basal ones may fork once.

Fertile pinnules are more rounded with three to four sporangiate sori, 0.7-0.8 mm in diameter. Other details are not visible.

Material—CTES-PB NO 10131, 10132.

Locality—400 m east of the railroad Gomero station, area of Concepcion, Chile.

Horizon—Talcamavida-Gomero Member (*sensu* Tavera Jerez, 1960).

Age—Upper Triassic.

Discussion—Only two fragmentary specimens (one fertile and other sterile) are in the collection, therefore it is not possible to establish close comparisons but it has been mentioned above that this form is rather similar to *G. gallegoi* (this paper). Thus it is being described as *Gleichenites* sp.

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