DISTRIBUTION OF THE FERNS OF THE FAMILY GLEICHENIACEAE IN THE PAST

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ABSTRACT

The distribution of the family Gleicheniaceae was studied first of all according to the data concerning the findings of spores and of the fossil leaves. The ancestors of these ferns (*Oligocarpia*) apppeared in the Carboniferous of Europe, North America and China.

During Triassic they were distributed in USA, Switzerland; in the Late Triassic of the USSR. The remnants of Gleicheniaceae were found sporadically in Jurassic beds of the East Greenland, Sweden, Italy, the USSR, India (Rajmahal series), Japan and USA.

During the Early Cretaceous Gleicheniaceae got an enormous distribution throughout the earth's surface. Their abundant remnants especially their spores were found in many localities of Eurasia, North America and Australia and it is with this time that coincide the greatest polymorphism of the family.

During the Late Cretaceous the remnants of these ferns mainly their spores are found in Europe, U.S.A. and the U.S.S.R.

The prevalent distribution of Gleicheniaceae in Eurasia during Jurassic and Cretaceous falls on the Indian-European paleofloristic area comprising the belt of subtropical and tropical climate.

With the advent of Paleogene the areal of Gleicheniaceae was greatly reduced in the Northern hemisphere and it begins to acquire a modern shape. The remnants of Gleicheniaceae of that time are presented mainly by rare findings of spores in Eurasia and North America.

THE distribution of the family Gleicheniaceae was studied first of all according to the date concerning the findings of spores and of the fossil leaves.

The most ancient representative of the family Gleicheniaceae is the genus *Oligocarpia*. This fern includes five species which appeared in the Carboniferous of Europe, China and America. The structure of sorus and sporangia of these ferns reminds us the same organs of the recent ones. But the spores have not characteristic features of this family. In the Permian deposits of China the fern *Chansitheca* was found; its sorus is similar to *Gleichenia* sorus. After great stratigraphical interval the leaf imprints of the genus *Dicranopteris* were found sporadically in the Triassic of Newarke (U.S.A.).

The leaf imprints, very often with sporangia, are described under the generic names *Gleichenia* or *Gleichenites*. They were found in Keuper of Switzerland (Basel) and Liassic of East Greenland, Sweden, Italy (the Alps of Verona), West Kazakhstan, Middle Asia* (FIG. 1).

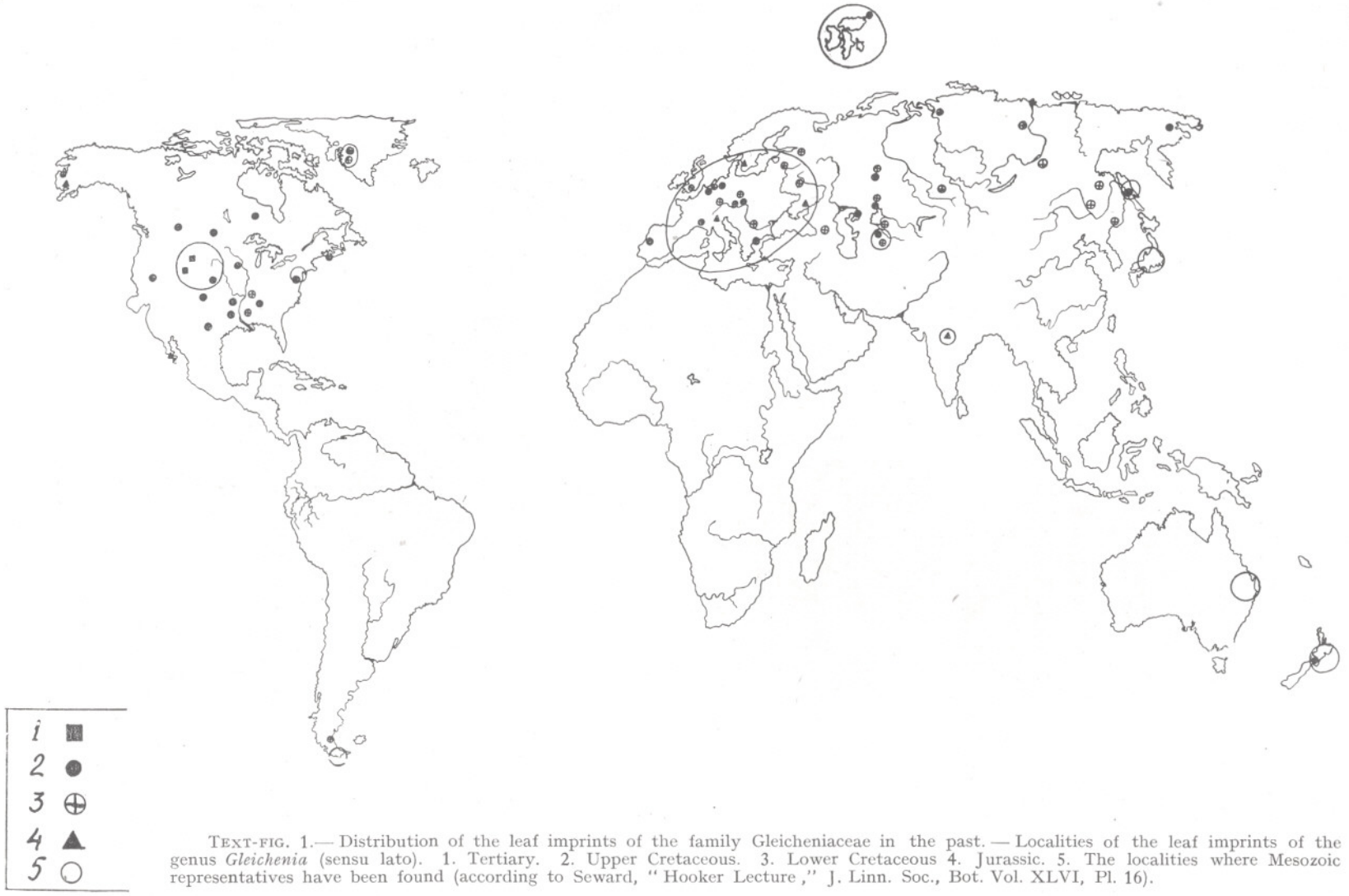
In the Middle Jurassic the leaf imprints of *Gleichenia* were found in Donezky basin, West Kazakhstan (the Ilek river), the mountain Gissar Range, South Fergana, India (Rajmahal series).

In the Upper Jurassic they were recorded in South Jacutia, Japan and the U.S.A. (California).

Numerous leaf imprints of *Gleichenia*, sometimes with sporangia, were found in Neocomian and especially in Aptian Eurasia and North America. They were described in Alaska, Greenland (Kome beds), in Spitzbergen, in England, Belgium, the F.R.G. In the Aptian deposits the leaf imprints of Gleicheniaceae were found near Moscow (Tatarovo, Karovo), in Voroneg region, in Dneprovsk-Donezk depression, Azerbajdjan, Kizil-Kum desert, West Siberia, on the lower course of rivers Jnisei and Lena, on the rivers Aldan, Bureja and in the South part of the Far East (Suchan and Sujfun basins). In the Albien deposits the leaf imprints were found in the middle Ural, the eastern regions near the Ural, West Kazakhstan and Kizil-Kum desert. In the Lower Cretaceous deposits the leaf imprints of *Gleichenia* were observed in Argentina (Patagonia).

In the Upper Cretaceous deposits the leaf imprints of *Gleichenia* were rarely found. They were recorded in Perutch beds of Czech (Cenomanien), Cenomanien of Kizil-Kum desert, Jana-Kolima area and Sakhalin, in the Upper part of Albien and Senomanian on the Atlantic coast of the U.S.A. (Raritan formation) and the central part of U.S.A. (Dakota formation). One species of *Gleichenia* was found in Turonian deposits of

*The regional distribution of the Gleicheniaceous remains goes from the west to the east.



TEXT-FIG. 1.— Distribution of the leaf imprints of the family Gleicheniaceae in the past. — Localities of the leaf imprints of the genus *Gleichenia* (sensu lato). 1. Tertiary. 2. Upper Cretaceous. 3. Lower Cretaceous 4. Jurassic. 5. The localities where Mesozoic representatives have been found (according to Seward, " Hooker Lecture ," J. Linn. Soc., Bot. Vol. XLVI, Pl. 16).

Italy and Portugal, numerous leaf imprints of *Gleichenia* were recorded in Senonian of G.D.R., on Sakhalin, on the Atlantic coast of the U.S.A. (Magoty formation) and West Greenland (Patut formation) Campanian, of the U.S.A. (Matavon group), in Maastrichtian-Danian of the U.S.A. (Vermeho and Larami formation), in the Tertiary deposits of Kuba (Miocen) and in the pliocen of the U.S.A. (Esmeralda formation). *Dicranopteris* leaf imprints were found in the Eocen deposits of England.

The fossil spores of Gleichenicaeae were found on the area of the U.S.S.R. in the Upper Triassic of the north-western part of Dnepr - Donez depression and Aktubinsk region, in Norian - Rhaetic on the Franz Josef Land. In the Lower Jurassic deposits they were recorded in the north-western part of Dnepr - Donez depression, Pavlodar region, Rhaetic - Liassic West Siberia, Lower Jurassic on the Franz Josef Land.

In the Middle Jurassic deposits these spores were found in the south-western part of Lithuania and Kaliningrad region, Volin district (West Ukraina), in the central region of the European Part of the U.S.S.R. — Orel, Belgorod, Kursk, Voroneg regions in the north-western part of Dnepr-Donez depression, along the Volga river (Saratov and Volgograd areas), in Crimea, on the North Caucasus and Daghestan, on Mangishlak, Aktubinsk region on North and West Kazakhstan, on the eastern slope of the Ural, of the Western Siberian depression and Irkutsk basin (Fig. 2).

In the Upper Jurassic deposits numerous spores of Gleicheniaceae were observed on the Russian Platform. They were found on the south part of the Baltic area, Gorky district; on the central region of European part of the U.S.S.R.— Kursk, Orel, Belgorod, Lipezk and Voroneg regions (near Balashov) they were found in Kelloveian, Oxfordian, Kimmeridgian deposits and in Kelloveian of the northern-western part of Dnepr - Donez depression, along the Volga river (Saratov and Volgograd areas); in the deposits of Lower Volgian stage these spores are predominant and present by some species. A relative amount of spores of the family Gleicheniaceae in the Upper Jurassic deposits of the central part of the Russian platform reaches 25-40 per cent of the assemblage of spores and pollen. The rare specimens of Gleicheniaceae spores were observed in the Upper Jurassic of the North Ural, on the eastern slope of the Ural and Mangishlak.

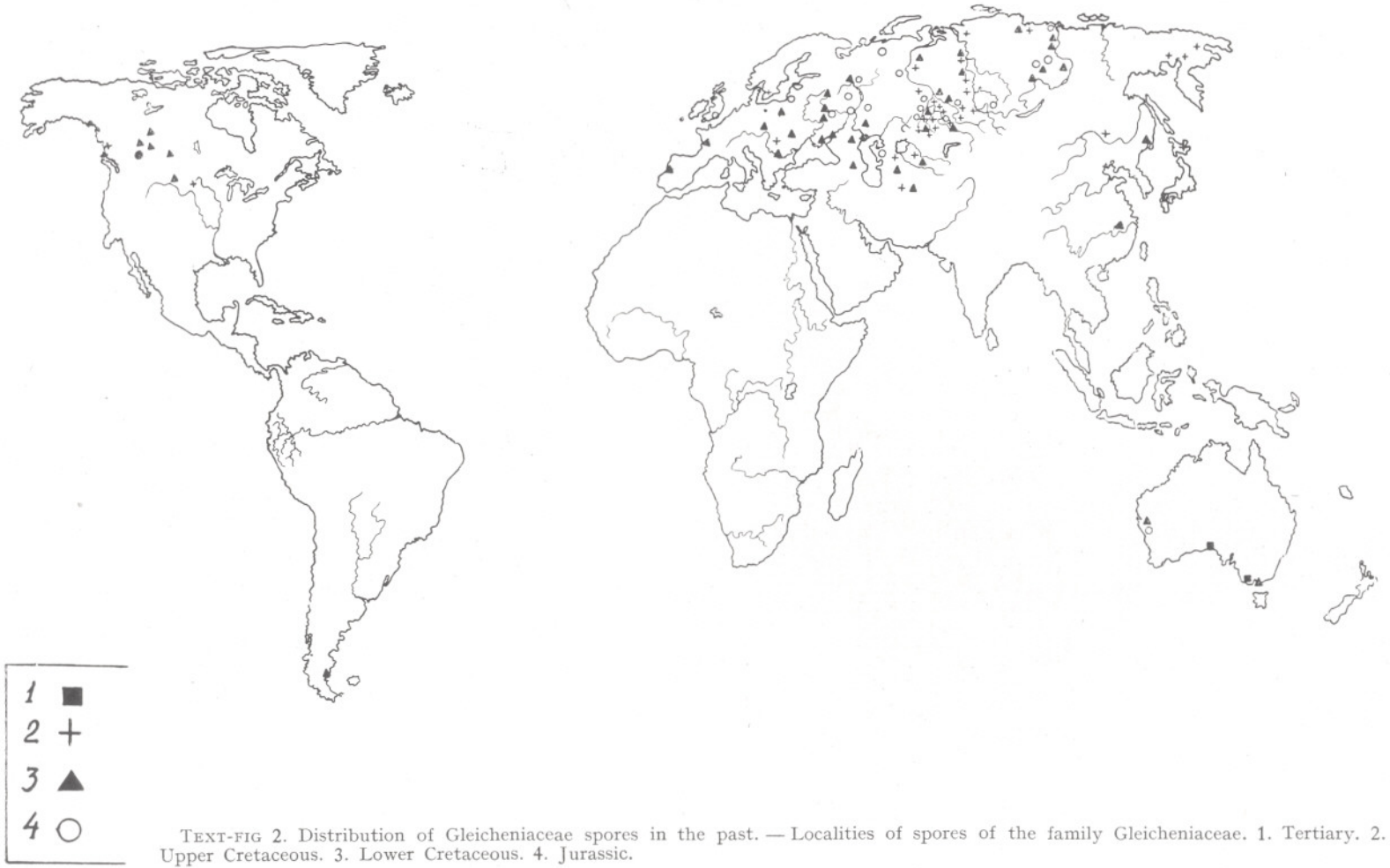
During the Early Cretaceous Gleicheniaceae got an enormous distribution throughout the Earth's surface. Their abundant remnants especially their spores were found in many localities of Eurasia, North America and Australia and it is with this time that gains the greatest polymorphism of the family.

In the Lower Cretaceous deposits the number of spores of Gleicheniaceae gradually increase and reaches its maximum in the Aptian. The greatest number of these spores was discovered in Aptian of the Russian Platform (till 60-80 per cent from the whall assemblage); they were less numerous in the southern part of this land — in the North Caucasus and Crimea.

In the Ural, in West Siberia, on the north of Siberia, in West Kazakhstan, on the Aral Sea region and Turkmenistan we can observe the same regularities. But in the Lower Cretaceous deposits of Jakutia (Viluj depression) spores of Gleicheniaceae were found more rarely, though in the Aptian-Albian deposits their amount reaches 13-15 per cent. In Hauterivian — Aptian deposits of the Far East (Sujfun and Sutchan coal basins) their spores are numerous.

In the assemblages of spores and pollen of the Upper Cretaceous deposits the representatives of the family Gleicheniaceae are distributed everywhere. They were found in Cenomanian of the Crimea, Upper Cretaceous of North Siberia, West Siberia, Viluj depression, on the north-east of Kamchatka, on the Amur river, in Blagoveschensk region. In the southern part of Soviet Asia they were found in Kazakhstan, Uzbekistan and Turkmenistan. During the Upper Cretaceous a relative amount and a number of species of Gleicheniaceae spores decreases, reaching 1-3 per cent in the Danian stage. Some species which were distributed in the Lower cretaceous disappeared.

In Paleocene, Eocene and Oligocene the spores of Gleicheniaceae appeared from time to time in Baltic area, in Ukraine, in the Crimea, the lower part of the Don river the North Caucasus, in the Volga area, West Siberia, in Kazakhstan, in Kamchatka and the Far East. In Miocene (to all appearance), the family Gleicheniaceae seems to retreat to the south, and it



TEXT-FIG 2. Distribution of Gleicheniaceae spores in the past. — Localities of spores of the family Gleicheniaceae. 1. Tertiary. 2. Upper Cretaceous. 3. Lower Cretaceous. 4. Jurassic.

remained only in the Caucasus and the nearest northern regions.

Beyond the boundary of the U.S.S.R. spores of Gleicheniaceae were found from the Middle Jurassic till Pliocene in Europe, Spitsbergen, Greenland, North America, Argentina, India, Japan, China, Australia, New Zealand.

A comparison of the dates concerning the distribution of the leaf imprints and spores of Gleicheniaceae shows that the number of species and a relative amount of spores of these plants increases from Triassic to Aptian. The most number of species were observed in the Neocomian — Aptian of Greenland and Aptian — Albian European province of Ind-European paleofloristic area as well comprising the belt of subtropical and tropical climate.

On the west of Europe — in the Albien of France they are not marked, though they were found in Aptian-Albian of Portugal (*Gleicheniidites senonicus Ross*). A somewhat lesser number of species was found in the Lower Cretaceous deposits in the provinces of Middle Asia, East Asia and India of the same area and still less species were discovered in the Siberia area. On the boundary of the Lower and Upper Cretaceous a sharp reduction of the number of Gleicheniaceae species in Eurasia took place, whereas in Greenland and North America and Sakhalin a great number of species remained during the whole Upper Cretaceous time. In the Paleogene these ferns have gradually disappeared from North Eurasia and remained only as one-two species in Paleogene and Neogene of North America. Now the representatives of the family inhabit in the tropics of both hemisphers. In the North hemisphere they reach Florida and California, in Asia they are distributed up to Korea and the South Japan islands, in Africa up to Kapland, in Australia, New Zealand and South America.

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