

A unique *Cycadocarpidium* from the Upper Triassic Nariwa Group, West Japan

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Abstract *Cycadocarpidium* cone scales are common in the Late Triassic floras in Northern Hemisphere. Many unique coniferous scales and their fragments assignable to the *Cycadocarpidium* were newly collected from the Nariwa Group. They are characterized by having bract-scales each with only two veins and three small-sized triangular ovuliferous scales and three ovules (seeds). These features are so unique that we herewith propose *Cycadocarpidium binerivium* sp. nov.

Many *Podozamites* leafy shoots are known from just above the present *Cycadocarpidium* bed, but both organs are not in organic connection.

Key Words *Cycadocarpidium*, Nariwa Group, Upper Triassic, West Japan.

Introduction

According to KON'NO (1961), diagnostic characters of genus *Cycadocarpidium* are as follows: Female cone is lax, cylindrical, with thin axis attached spirally by cone-scales; cone scale consists of sterile bract and ovuliferous scale; sterile bract large, leafy, ovate to lanceolate in form, traversed by many parallel veins, which are all confluent into long stalk-formed petiole (pedicel) with remarkably decurrent base; ovuliferous scale is small in size, bi- or trilobed at distal part, each lobe of which bears one ovule being tightly attached to oblong ovule-cushions (these characters are partly neglected). This genus now indicates more than 20 species which may be classified by the number of ovules in an ovuliferous scale into major divisions bi- or triovulate; each of them is further divided into subdivisions by such criteria as; number of veins in bract, size and form of blade of bract, size and form of ovule (see Table).

The present specimens are quite unique, because the veins of each bract scale are only two in number. This paper deals with the description of detached cone scales as a new species.

Table. *Cycadocarpidium* species hitherto known and

	Bract scale			Seed scale complex		Cone stalk L/W (mm)	Sources and Ages
	Form	Size L/W (mm)	Veins	Seeds			
				Size, L/W (mm)	Number		
<i>C. erdmanni</i> NATHORST, 1886	ovate	small (7.5-10.5) × (3-3.2)	4-6	small 3 × 2	2	short, narrow, weak	Scania T ₃ ³
<i>C. swabii</i> NATHORST, 1911	narrowly ovate	middle (23-26) × (4.7-6)	8-10	small 3 × 2	2	4 × (1.5-2)	Scania T ₃ ³
<i>C. redivivum</i> NATHORST, 1911	small ovate	very small 5 × 2	4	small	2		Scania T ₃ ³
<i>C. minor</i> TURTANOVA-KETOVA, 1931	lanceo- late	small (4-10) × (3-4)	4	small 1.5-1	2	4 × (1.5-2)	Kirgis T ₃ ² -J ₁
<i>C. parvum</i> KRYSHTOFOVICH et PRYNADA, 1932	elon- gate ovate	small-mid- dle (8-19) × (4-6.5)	4-6	middle	2		Southern Ussuri T ₃ ²
<i>C. tricarpum</i> PRYNADA, 1940	ellip- tic	middle 22 × 7	7	middle-small 2.0-1.6	3	6 × 2	Eastern slope of Ural
<i>C. ferganiensis</i> TURTANOVA-KETOVA, 1950	elon- gate ovate	middle- small 18 (15-22) × 3-5 (4-7)	4-6	2 × 1	2		Fergana T ₃ ² -J ₁
<i>C. naitoi</i> KON'NO, 1961	ellip- tic	middle- small (15-17) × (3.6-4)	6	middle-small (2.1-3.3) × (0.8-1.8)	3	(5-8) × (0.53 -0.8)	Yamaguchi, Japan T ₃ ¹⁻²
<i>C. osawae</i> KON'NO, 1961	ovate- short lanceo- late	middle- small (14.3- 18.5) × 4.6	6	small (1.6-2.3) × (1.2-1.3)	3	longer	Yamaguchi, Japan T ₃ ¹⁻²
<i>C. osawae</i> var. <i>minense</i> KON'NO, 1961	ellip- tic	(9.5-14) × (2.8-5.3)	6	small 1.8-1.2	3	(4.5-5) × (0.56- 0.6)	Yamaguchi, Japan T ₃ ²

their brief references (after SUN, 1979 in part).

	Bract scale			Seed scale complex		Cone stalk L/W (mm)	Sources and Ages
	Form	Size L/W (mm)	Veins	Seeds			
				Size, L/W (mm)	Number		
<i>C. nagatoense</i> KON'NO, 1961	elongate-ovate	middle-small (10–23) × (4–9)	9–12	middle-small 2.7 × (1.8–2.1)	3	7 × 1.1	Yamaguchi, Japan T ₂ ² –T ₃ ²
<i>C. asaense</i> KON'NO, 1961	ovate	20 × 7	10	larger 6 × 2	2		Yamaguchi, Japan T ₂ ² –T ₃ ²
<i>C. issykkulensis</i> GENKINA, 1966	ovate-linear	middle-large (39–42) × (9–11)	9–11	2.5 × (1.5–2)	2	(4–6) × 2	N-Kirgistan T ₃ ²
<i>C. sogtensis</i> GENKINA, 1966	elongate-ovate	middle (23–28) × (6–8)	11–13	middle (3–4) × (1.5–2)	2		N-Kirgistan T ₃ ²
<i>C. insignis</i> GENKINA, 1966	elongate-ovate	large (30–45) × (7–11)	8–10	small 2 × 1	2	(3–5) × 1.5	N-Kirgistan T ₃ ² –J ₁
<i>C. dzergalanensis</i> GENKINA, 1966	elongate-lanceolate	middle (27–30) × (3–5)	7–8	1 × 1	2		N-Kirgistan T ₃ ³ –J ₁
<i>C. tricarpum</i> PRYNADA (s. 1.), 1978	ovate-lanceolate	generally middle (15–18) × (3.5–5)	5–6	(2–2.5) × (1–1.5)	3	5.0	Tianqiaoling NE-China T ₃
<i>C. giganteum</i> SUN, 1978	broadly lanceolate	generally large (55–60) × (13–14)	14–17	large (6–7) × (4–4.5)	2	10 × 1	Tianqiaoling NE-China T ₃
<i>C. elegans</i> SUN, 1978	lanceolate	large 66 × 11	8	5 × (4–5)	2	long	Tianqiaoling NE-China T ₃
<i>C. brachyglossum</i> ZHANG, 1982			2		2		

Systematic description

Coniferales (or Podozamitales)

Family Cycadocarpidiaceae

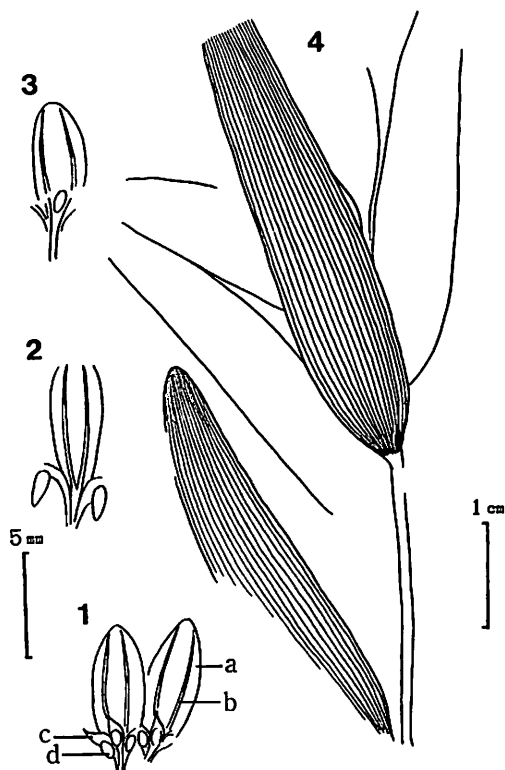
Genus *Cycadocarpidium* NATHORST, 1886

Type species: *Cycadocarpidium erdmanni* NATHORST, 1886

Cycadocarpidium binerivium KIMURA and OHANA, sp. nov.

Figures 1-3

Material: Holotype; KMNHGP100,002 (Figure 1). Paratype; KMNHGP100,003, KMNHGP100,004 (Figures 2-3), and many fragments of the bract scales. All of the fossils were preserved as silvery impressions (due to fine graphitoid substance).



Figs. 1-3. Detached cone-scales, each consisting of a bract and three ovuliferous scales.

Figs. 1, 3 — adaxial views; Fig. 2 — Abaxial view. a — sterile bract scale, b — vein, c — ovuliferous scale with seed (ovule) (d).

Fig. 4. A detached leafy-shoot of *Podozamites* sp.

represented by little relief. The high thermal maturity of the sediments has rendered the cuticle unsuitable for epidermal study. Due to the lower contrast between the specimens and the matrix, photography was unsuccessful. Specimens described here are deposited in the Kitakyushu Museum and Institute of Natural History.

Locality and horizon: Matsubara, Kawakami-cho, Kawakami-gun, Okayama Prefecture (roughly 133°27'43"E, 34°42'54"N); collected by Masahiko KATAYAMA.

Typical stratum: Corresponding to non-marine Hinabata Formation; middle-lower part of the Nariwa Group (Upper Triassic). A new locality of fossil plants, located to the southwest of main fossil sites shown by OISHI (1932).

Etymology: The specific epithet is derived from two veins in each bract-scale.

Description: Obtained specimens are all detached cone-scales (sporophylls). A cone-scale consists of a bract-scale (sterile portion) and three ovuliferous scales.

Bract-scale is oval in form, 7 mm long and at most 2.5 mm wide with two simple veins. A short and slender pedicel on adaxial side is present. Seeds (or ovules) are oval and three in number each with obliquely placed triangular lamina (ovuliferous scale). Veins are comparatively thick, originated from the top of pedicel, then running in parallel with the margin of bract-scale, not converging at apex.

Ovule (seed) is small-sized, about 0.75 mm long and its internal structure is not known. Cuticle of bract- and ovuliferous scales is not preserved.

Discussion and comparison: The present specimens are characterized by small-sized detached bract-scales, each with two veins and three ovuliferous scales and ovules (seeds).

So far as we know, features as mentioned above are unique, especially having only two veins in each bract-scale.

SUN (1979, pp. 322–323) listed 20 *Cycadocarpidium* species briefly with their characteristic features including size and sources of the literature. In his list, we could not recognize the bract-scale with two veins. The number of veins varies according to the species and ranges from 4 to 17.

Subsequently, ZHANG (1982) described *Cycadocarpidium brachyglossum* having two veins in a bract-scale as a new species, from the Upper Triassic Laohugou Formation, Lingyuan, Liaoning Province, North China. ZHANG's species is characterized by the comparatively broad bract-scale and by having two rather large sized ovules (seeds) without ovuliferous lamina. Accordingly, the present cone-scales are specifically distinct and are different from the ZHANG's cone-scales and thus we regard the present cone scales as belonging to a new species, and *Cycadocarpidium binerivium* n. sp. is herewith proposed.

In the Upper Triassic floras in the Northern Hemisphere, detached *Cycadocarpidium* cone-scales are commonly in association with the *Podozamites* leafy-shoots. In the present plant-sites, many detached *Podozamites* leafy-shoots are

known (Figure 4) from just above the horizon yielding detached *Cycadocarpidium binerivium*. However, it is difficult to determine these *Podozamites* leafy-shoots and *Cycadocarpidium* cone-scales belong to the same plant.

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