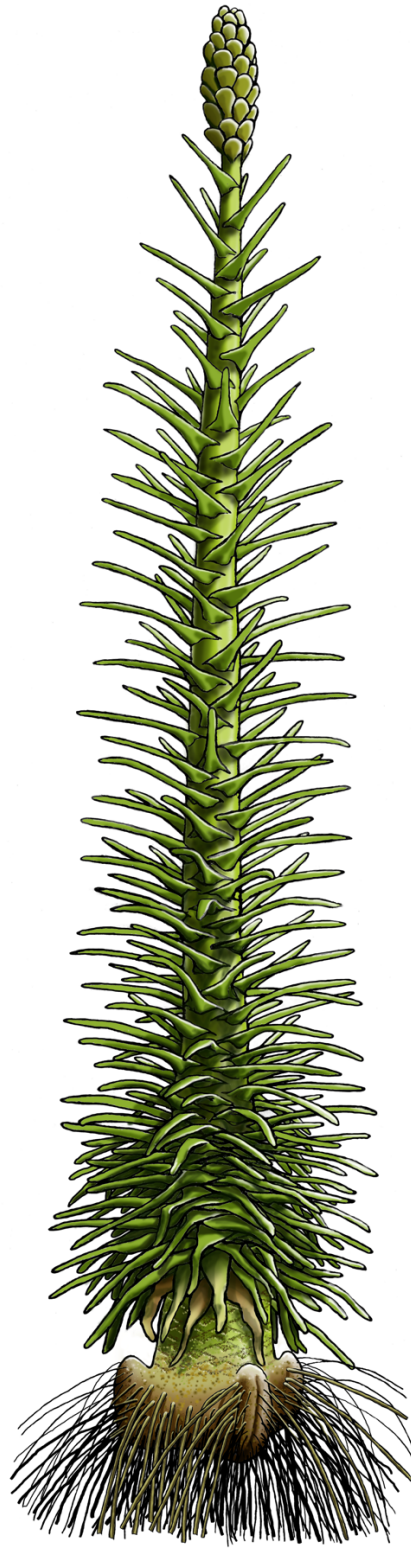


**Supplementary Figure 1.** Variable vertical growth rates of *Pleuromeia sternbergii*. The cumulative number of leaves along the stem (starting with the oldest leaves) is plotted against height. Thus, the slope of the line is the vertical growth rate in cm per plastochron (i.e. the amount of time between the development of consecutive leaf primordia; see Materials and Methods). The green rectangles indicate the amount of vertical growth represented by intervals of 10 consecutive leaves (small grey rectangles at the end of the segments represent extrapolations for incomplete intervals of 10). Lower case letters refer to the fossils in the trace diagrams in Figure 3. Stem segments a-d contain the apex of the stem; segments d and k-o contain the basal part of the stem; e-j represent stem fossils that lack apex and base.



**Supplementary Figure 2.** Reconstructed growth habit of *Pleuromeia sternbergii* (height circa 1.5 m; reconstruction by Ivo Duijnste and Hannah Bonner). Same illustration as in Figure 4A, but at a higher resolution.

**Supplementary Table 1.** Counted Lopingian and Triassic plant taxon occurrences in the fossil data compilation by Nowak et al. (2019) after removal of non-embryophytic palynomorphs and filtering for stage-level chronostratigraphic assignability.

	MEGAFOSSIL DATA			MICROFOSSIL DATA		
	Recorded plant taxa	Recorded isoëtalean taxa	% isoëtaleans	Recorded plant taxa	Recorded isoëtalean taxa	% isoëtaleans
Rhaetian	181	0	0.0	—	—	—
Norian	116	0	0.0	102	12	11.8
Carnian	879	11	1.3	945	67	7.1
Ladinian	2,892	69	2.4	13,599	1,084	8.0
Anisian	1,335	107	8.0	11,581	1,400	12.1
Olenekian	662	83	12.5	4,090	981	24.0
Induan	607	100	16.5	10,792	2,389	22.1
Changhsingian	1,337	6	0.4	4,175	105	2.5
Wuchiapingian	1,874	0	0.0	1,278	10	0.8
Total	9,883	376		46,562	6,048	

**Supplementary Table 2.** Counted Lopingian and Early Triassic plant taxon occurrences in the fossil data compilation by Nowak et al. (2019) after removal of non-embryophytic palynomorphs and filtering for paleogeographic floral province assignability.

		MEGAFOSSIL DATA			MICROFOSSIL DATA		
		Recorded plant taxa	Recorded isoëtalean taxa	% isoëtaleans	Recorded plant taxa	Recorded isoëtalean taxa	% isoëtaleans
EARLY TRIASSIC	(Sub)Angara	445	81	18.2	8,152	2,045	25.1
	Cathaysia	597	73	12.2	1,263	109	8.6
	Euramerica	270	37	13.7	3,061	430	14.0
	Gondwana	298	26	8.7	4,213	1,018	24.2
LOPINGIAN	(Sub)Angara	500	8	1.6	1,298	79	6.1
	Cathaysia	2,528	0	0.0	1,065	16	1.5
	Euramerica	921	0	0.0	3,707	74	2.0
	Gondwana	248	0	0.0	4,748	172	3.6