

Stems of a New Osmundaceous Fern from the Middle Jurassic of Kursk Region, European Russia

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Abstract—New species of osmundaceous ferns, *Osmundastrum gvozdevae* sp. nov., is established on the basis of small coalified stems with preserved cellular structure, originated from the Upper Bathonian deposits of the Mikhailovskii Rudnik locality (Kursk Region, European Russia). Vascular tissues of the stem are represented by ectophloic dictyoxyletic siphonostele; pith homogenous, comprising prosenchymatous cells only. Xylem of the leaf trace is endarch, with protoxylem strand, bifurcating when passes through the external part of an outer cortex. Leaf bases with stipular wings; their vascular bundles are horseshoe-shaped, with two sclerenchyma masses on the side of adaxial concavity. Sclerenchyma rings in the leaf bases are heterogeneous, thick-walled fibers form distinct abaxial arch and two lateral masses. The new species is provisionally assigned to the extant genus *Osmundastrum* C. Presl on the basis of the stem anatomical peculiarities.

Keywords: Osmundaceae, morphology, anatomy, Middle Jurassic

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INTRODUCTION

The peak of diversity of ferns of the subfamily Osmundoideae R. Br. ex Sweet falls in the Mesozoic (Bomfleur et al., 2017). At that time, they occurred nearly everywhere. In the geological record, the remains of sterile foliage prevail, whereas finds of anatomically preserved stems are rather rare. The vast majority of stems of Mesozoic osmundaceous ferns with preserved anatomical structure was described from the Southern Hemisphere (Antarctica, Southern America, Australia, and New Zealand). In the North Hemisphere, finds are less numerous and come mainly from Mexico, USA, Canada, India, and China (Arnold, 1945; Miller, 1971; Rothwell et al., 2002; Tian et al., 2016; Bomfleur et al., 2017). On the territory of North Eurasia, Osmundaceae are known from abundant remains of foliage *Cladophlebis* Brongn., *Raphaelia* Debey et Ettingshausen, and *Todites* Seward, at the same time, only two osmundaceous ferns were described on the basis of stems with preserved anatomical structure: *Millerocaulis tuhajkulensis* (Prynada) Bomfleur, G.W. Grimm et McLoughlin from the Late Triassic deposits of eastern slope of the Urals and *Osmundastrum pulchellum* (Bomfleur, G.W. Grimm et McLoughlin) Bomfleur, G.W. Grimm et McLoughlin from the Toarian (Lower Jurassic) deposits of Sweden (Prynada, 1974; Bomfleur et al., 2015, 2017). Thus, the new find becomes the third in the territory under consideration.

In the anatomical characters of stem, the new species is most similar to the genus *Osmundastrum*, to which authors assign it provisionally, because on the available material it is impossible to establish all key characters of the extant genus.

MATERIAL AND METHODS

The material studied comes from the Upper Bathonian deposits of Mikhailovskii Rudnik open mine near the town of Zheleznogorsk (Kursk Region), from the clayey lens at the base of the Arkinsk Formation section, exposed in the northern wall of the northern open mine (for characteristics of the deposits and list of fossil plant taxa of the lens, see Broushkin and Gordenko, 2018).

The remains of stems of the new fern are rare; in association with them, among other plants, numerous fragments of sterile fronds *Cladophlebis* sp. were found. Plant remains are lignified, more rarely vitrified; cellular structure of some specimens is comparatively well preserved, with the exception of tissues located between the cortex and xylem, as well as (partly) of the inner cortex. In some areas of splits, the cell wall thickness is significantly distorted due to the gelification of plant tissues during fossilization. The material is brittle and easily destroyed when wetted, which does not allow to prepare thin sections from it. The anatomical structure of the stems was studied on transversely and longitudinally fractured surfaces

using stereomicroscope Leica M165C with digital camera Leica DFC 420C and SEM Tescan. Coalified stems fragments poorly endure coating for SEM and crumble when using the high vacuum mode, therefore predominantly low vacuum mode was used (BSE detector, 20 kV), without coating. Small fragments of petiole bases and stems were studied in the high vacuum mode (SE detector, 30 kV), with a gold and palladium coating.

The material is housed in the Borissiak Paleontological Institute of the Russian Academy of Sciences, Moscow (PIN), collection no. 5173.

SYSTEMATIC PALEOBOTANY

DIVISION PTERIDOPHYTA

Order Osmundales

Family Osmundaceae Martynov, 1820

Subfamily Osmundoideae R. Br. ex Sweet, 1826

Tribe Osmundae Hook. ex Duby, 1828

Genus *Osmundastrum* C. Presl, 1847

Osmundastrum gvozdevae N. Bazhenova et A. Bazhenov, sp. nov.

Pl. 14, Figs. 1–13; Pl. 15, Figs. 1–7

Etymology. In honour of hydrogeologist of Mikhailovskii Rudnik open mine Olga Victorovna Gvozdeva.

Holotype. PIN, no. 5173/70, stem fragment with partly preserved leaf bases; European Russia, Kursk Region, vicinity of the town of Zheleznogorsk, Mikhailovskii Rudnik open mine; Middle Jurassic, Upper Bathonian, Arkinsk Formation (Pl. 14, Fig. 1); designated here.

Diagnosis. Stems 3–5 mm in diameter. Stele ectophloic dictyoxyle siphonostele, 0.6–0.9 mm in diameter, with 9–14 strands up to 8 tracheids thick. Leaf gaps narrow, complete. Pith about 0.4–0.6 mm in diameter, consisting of elongated cells with relatively thick walls. Cortex composed of narrow inner layer and wide outer layer. Inner cortex parenchymatous, comprising up to three leaf traces. Outer cortex fibrous, homogenous, with up to 14 leaf traces. Leaf traces oblong, with slight adaxial curvature and single endarch protoxylem group, bifurcating when leaf trace passes through external part of outer cortex. Diarch root traces arising from leaf traces in pairs or singly, occasionally before traces leave stele. Sclerotic rings in petiole bases heterogeneous, thick-walled fibers form distinct abaxial arch and two lateral masses. Adaxial concavity of vascular bundle with two sclerenchyma masses. Stipular wings with large oblong sclerenchyma mass and several small masses scattered distally. Inner cortex with two–three medium-sized lateral sclerenchyma masses and additional small oblong abaxial sclerenchyma mass.

Description (Figs. 1–3). The remains studied are represented by small fragments of unbranched

stems, up to 31 mm long, 3–5 mm in diameter; the mantle of leaf bases and roots in most of the exemplars is not preserved, partly preserved only in two exemplars (Pl. 14, Figs. 1, 4, 6). The stele is ectophloic dictyoxyle siphonostele, 0.6–0.9 mm in diameter, with 9–14 vascular strands up to eight tracheids thick (Pl. 14, Figs. 6, 7; Pl. 15, Figs. 1–4). Vascular bundles are mesarch (Pl. 15, Fig. 4), composed of tracheids with scalariform bordered pits (Pl. 15, Fig. 7); tracheid diameter attains 45 μ m. Leaf gaps are narrow, complete (Pl. 15, Figs. 3, 6). The pith is about 0.4–0.6 mm in diameter, homogenous, composed of longitudinally elongated cells up to 25 μ m in diameter, up to 135 μ m in length, with relatively thick walls (Pl. 14, Fig. 8; Pl. 15, Figs. 2, 3).

The zone, corresponding to phloem, endodermis, and pericycle collapsed, therefore the structure of these tissues is unknown. The cortex consists of a very narrow inner layer, which partly or completely collapsed in all exemplars (width of the collapsed zone is 20–50 μ m; a small number of leaf traces within it suggest that initially this zone was sufficiently narrow), and wide outer layer, up to 1200 μ m thick (Pl. 14, Figs. 5–7; Pl. 15, Fig. 1). The inner cortex comprises up to three leaf traces (Pl. 15, Fig. 2; Fig. 3c). The outer cortex is homogenous, consists of relatively thin-walled fibers, which attain a diameter of 25 μ m and a length of 200 μ m, and comprises up to 13 leaf traces (Pl. 14, Figs. 5–7; Pl. 15, Fig. 1; Fig. 3c). The leaf traces are oblong, with a small adaxial concavity and single endarch protoxylem group (Pl. 14, Fig. 10; Pl. 15, Fig. 6) bifurcating when the leaf trace passes through the outer part of outer cortex of stem (Pl. 14, Fig. 11). The leaf traces depart from stele at an angle of approximately 25°–30°. Thickness of xylem in leaf traces is about 65 μ m (3–4 cells), width 100–165 μ m; in the outer cortex of stem, leaf traces become distinctly C-shaped, attain a width of 190 μ m and thickness 97 μ m (five cells). Root traces are diarch, depart from the leaf traces in pairs (Pl. 14, Fig. 9) or singly (Pl. 14, Fig. 4), occasionally before leaf trace leaves the stele (Pl. 15, Fig. 5; Fig. 3c). On entering the leaf base, leaf traces attain a width of 450 μ m.

Leaf bases (without stipular wings) have ellipsoidal outlines in cross-section and attain a width of 1500–1600 μ m. A sharp boundary between the inner and outer cortex in petiole bases is absent (Fig. 1a). The most thin-walled cells of the inner cortex, adjacent to the vascular bundle, collapsed (Figs. 1a–1c; 2a, 2b; 3a). Sclerenchyma rings in petiole bases are heterogeneous (Figs. 1c; 2a, b; 3a, 3d). In the outer cortex, only relatively thin outer layer (30 μ m, 4–6 cells thick) consists of comparatively thick-walled fibers of small diameter, 4–15 μ m (Figs. 1a–1c; 2a, 2b; 3a). The abaxial sclerenchyma arch develops gradually. Immediately after petiole departure from the stem, thick-walled sclerenchyma in the cortex is absent (Figs. 1a; 3d). Initially, a thin arch with slightly thickened ends is formed (Fig. 1b), then it gradually thickens, and lat-

eral sclerenchyma masses appear at a small distance from the arch ends (Figs. 1c; 3d). At this stage, two small sclerenchyma masses from the side of the concavity of vascular bundle become visible (Figs. 1d; 3d). Occasionally, one of the sclerenchyma masses appears relatively early, already at the level of petiole departure from the stem (Pl. 14, Fig. 11). When the sclerenchyma masses in the concavity of the vascular bundle become larger, two lateral middle-sized sclerenchyma masses appear in the inner cortex on each side of the vascular bundle (Figs. 2a; 3d), then one of them (or both, Fig. 3a, 3d) divides into two, and an abaxial thin arch-shaped mass appears (Figs. 2b; 3b, 3d). Sclerotic ring in the outer cortex attains a thickness of 100 μm . Stipular wings at this stage are supplied with large oblong sclerenchyma mass and additional small sclerenchyma masses in distal part (Pl. 14, Figs. 12, 13; Fig. 3d).

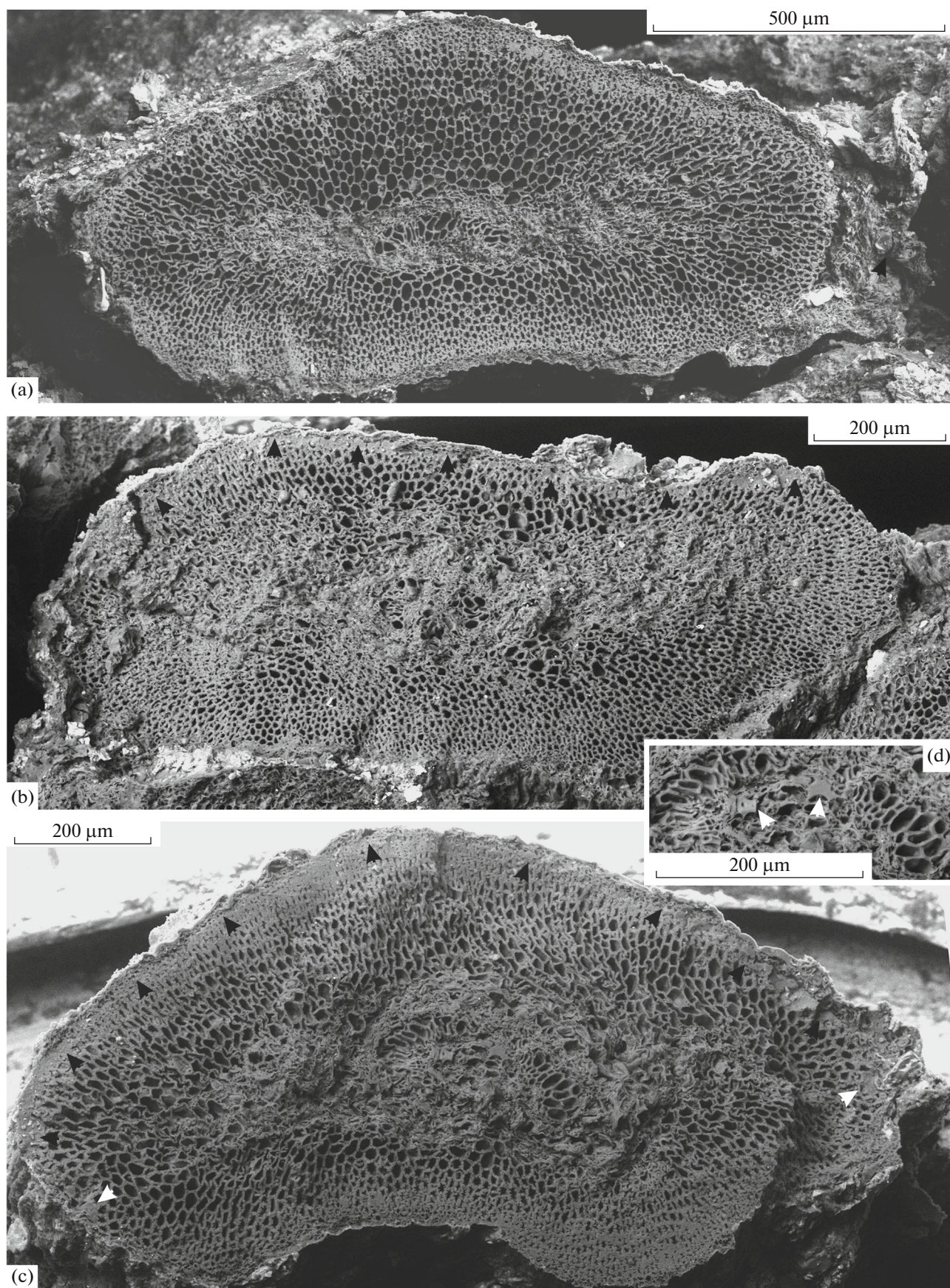
Comparison. The fern from Mikhailovskii Rudnik exhibits features (type of stele, number of bundles in stele, type of leaf gaps formation, structure of sclerotic rings, etc.), characteristic for some extant and fossil representatives of subfamily Osmundoideae, tribe Osmundae. On the basis of the presence of two lateral sclerenchyma masses and an abaxial arch in the outer cortex of petiole base and late bifurcation of leaf trace protoxylem in the new species, we provisionally assign it to the genus *Osmundastrum*, to which four species are currently attributed: extant *O. cinnamomeum* (L.) C. Presl, *O. precinnamomeum* (C.N. Miller) Bomfleur, G.W. Grimm et McLoughlin from the Paleocene of North America, *O. indentatum* (R.S. Hill, S.M. Forsyth et F. Green) Bomfleur, G.W. Grimm et McLoughlin from the Late Triassic of Tasmania, and *O. pulchellum* from the Toarian (Lower Jurassic) deposits of Sweden (Hill et al., 1989; Bomfleur et al., 2015, 2017). Among them, *O. indentatum* is most similar to the new species in the structure of the sclerotic ring in petiole bases, namely in the presence of thin sclerenchyma arch and two lateral sclerenchyma masses. Moreover, in *O. indentatum*, as in *O. gvozdevae* sp. nov., there are two sclerenchyma masses in the adaxial concavity of vascular bundle. The new species, however, differs from *O. indentatum* in the presence of sclerenchyma masses in the inner cortex and different pattern of sclerenchyma masses in stipular wings (in the new species they are oblong, whereas in *O. indentatum* they are rounded and accompanied by numerous scattered separate strands). The stele in *O. indentatum* consists of about 20 vascular bundles (up to 18 tracheids thick), leaf gaps are incomplete, the inner cortex comprises up to 13 leaf traces, the outer scleren-

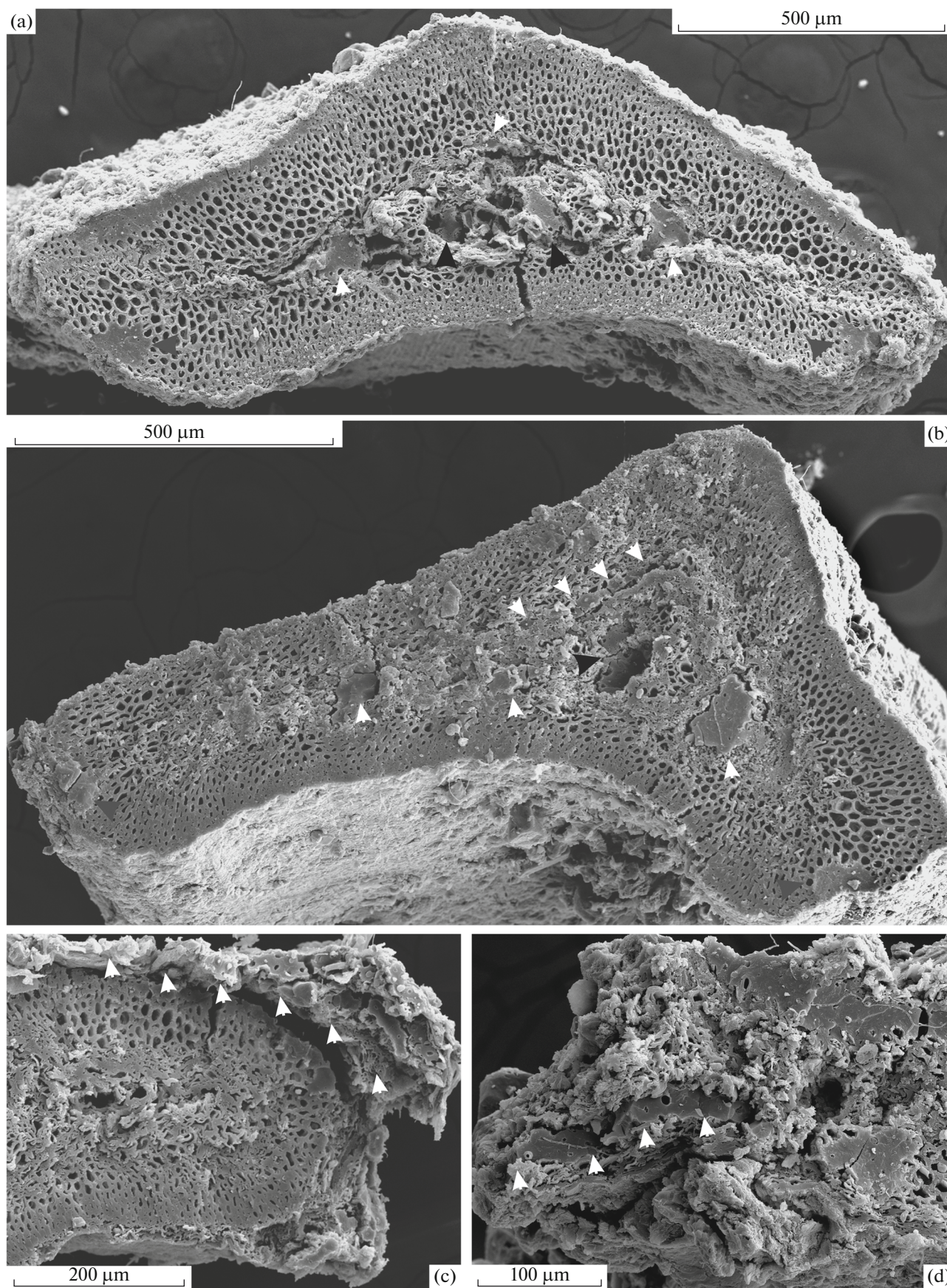
chymatose cortex comprises up to 27 leaf traces, thus the vascular bundles and leaf traces in *O. indentatum* are sufficiently more numerous than in the new species. Root traces in *O. indentatum* are only single. The stem diameter in the latter is three times as much as in the new species; *O. indentatum* is supposed to be arborescent (Hill et al., 1989).

Another Mesozoic species, *O. pulchellum*, exhibits less similarity to the new species, despite a relative geographical proximity and close position in the geological record. In the new species, as well as in *O. pulchellum*, sclerenchyma masses in stipular wings are oblong. However, *O. gvozdevae* sp. nov. possesses several smaller additional masses, which are not observed in *O. pulchellum*. All three sclerenchyma masses in the outer cortex of leaf bases in *O. pulchellum* are massive and represent derivatives of initial abaxial arch, whereas in the new species, lateral sclerenchyma masses appear independently on a short distance from an abaxial arch. In contrast to the new species, in *O. pulchellum* a single large horseshoe-shaped sclerenchyma mass is observed in the adaxial concavity of vascular bundle (Bomfleur et al., 2015, 2017). The thickness of vascular bundles in a stele of the new species is slightly less, than in *O. pulchellum*; the stele is of the same type, but in *O. pulchellum* it comprises up to 20 vascular bundles (their number noticeably exceeds the number of vascular bundles in stele of the new species). The number of leaf traces in the inner cortex of the new species is three times, and in the inner cortex—nearly twice smaller. The root traces in *O. gvozdevae* sp. nov. depart from leaf traces in pairs or singly, whereas in *O. pulchellum* they are single. The stem in the new species exhibits approximately twice smaller diameter.

O. gvozdevae sp. nov. is similar to extant *O. cinnamomeum* in independent appearance of lateral sclerenchyma masses in sclerotic rings (Miller, 1971). At the same time, in the oldest fossil, assigned to *O. cinnamomeum* (Serbet and Rothwell, 1999), all three sclerenchyma masses in the outer cortex of leaf bases represent derivatives of initial abaxial arch (as in *O. pulchellum*). It may either reflect variability of the character, or suggest that the Late Cretaceous fern, despite significant similarity to the extant *O. cinnamomeum*, represents a separate species. Both in *O. cinnamomeum* and in *O. gvozdevae* sp. nov., there are two sclerenchyma masses in the adaxial concavity of the vascular bundle. The type of stele in *O. gvozdevae* sp. nov. corresponds to that of *O. cinnamomeum*. Number of vascular bun-

Fig. 1. *Osmundastrum gvozdevae* sp. nov., holotype PIN, no. 5173/70, SEM: (a) petiole base immediately after its departure from stem, the vascular bundle with slight adaxial concavity, surrounded by two-layered cortex, is seen; on the right, poorly preserved stipular wing with scattered thick-walled fibers (marked by arrow) is visible; (b) petiole base at the stage of abaxial arch development in the outer cortex (marked by black arrows), one can see that the adaxial concavity of vascular bundle becomes more pronounced; (c) petiole base at the stage of lateral sclerenchyma masses formation in the outer cortex (lateral masses are indicated by white arrows, abaxial arch—by black arrows), the vascular bundle becomes much wider; (d) detail of Fig. 1c, two small sclerenchyma masses in the adaxial concavity of vascular bundle are visible (marked by white arrows).





dles in the stele and of leaf traces in the inner and outer cortex of the new fern falls within the range of variability of *O. cinnamomeum*. Root traces in the latter depart from leaf traces singly, more rarely in pairs, which also may be regarded as an additional similarity. At the same time, the new species differs from *O. cinnamomeum* by the presence in the petiole base outer cortex of abaxial arch, instead of massive rounded sclerenchyma mass.

Some researchers consider *O. precinnamomeum* as a probable junior synonym of *O. cinnamomeum* (Serbet and Rothwell, 1999). Ch. Miller assigned this fern to a separate species on the basis of the presence of small strands of thick-walled fibers scattered throughout in the inner cortex of leaf bases, emphasizing that as a single essential difference (Miller, 1971). The presence of thick-walled fibers in the inner cortex is characteristic of the new species too, but in the latter, a certain regularity in their distribution is observed.

An important difference of the new species from other representatives of *Osmundastrum* is the structure of pith and outer cortex. In the new species, all cells of pith possess distinctly thickened walls, comparable in their thickness to the walls of outer cortex cells. At the same time, the outer cortex in *O. gvozdevae* sp. nov. is less sclerified, than in other species of this genus.

R e m a r k s. Judging by number of leaf traces, the mantle of leaf bases in *O. gvozdevae* sp. nov. was poorly developed. Size of the stems indicates that the new fern was not arborescent, unlike the majority of fossil Osmundales; probably, in its habit *O. gvozdevae* sp. nov. corresponded to extant *Osmundastrum cinnamomeum*.

In close association with the stems, numerous fragments of small pinnate leaves *Cladophlebis* sp., similar in their pinnules morphology to *Osmundastrum cinnamomeum* and *Claytosmunda claytoniana* (L.) Metzgar et Rouhan, were found (Figs. 3e, 3f); most probably, they represent the foliage of *Osmundastrum gvozdevae* sp. nov.

M a t e r i a l. Six exemplars, represented by lignified fragments of stems.

DISCUSSION

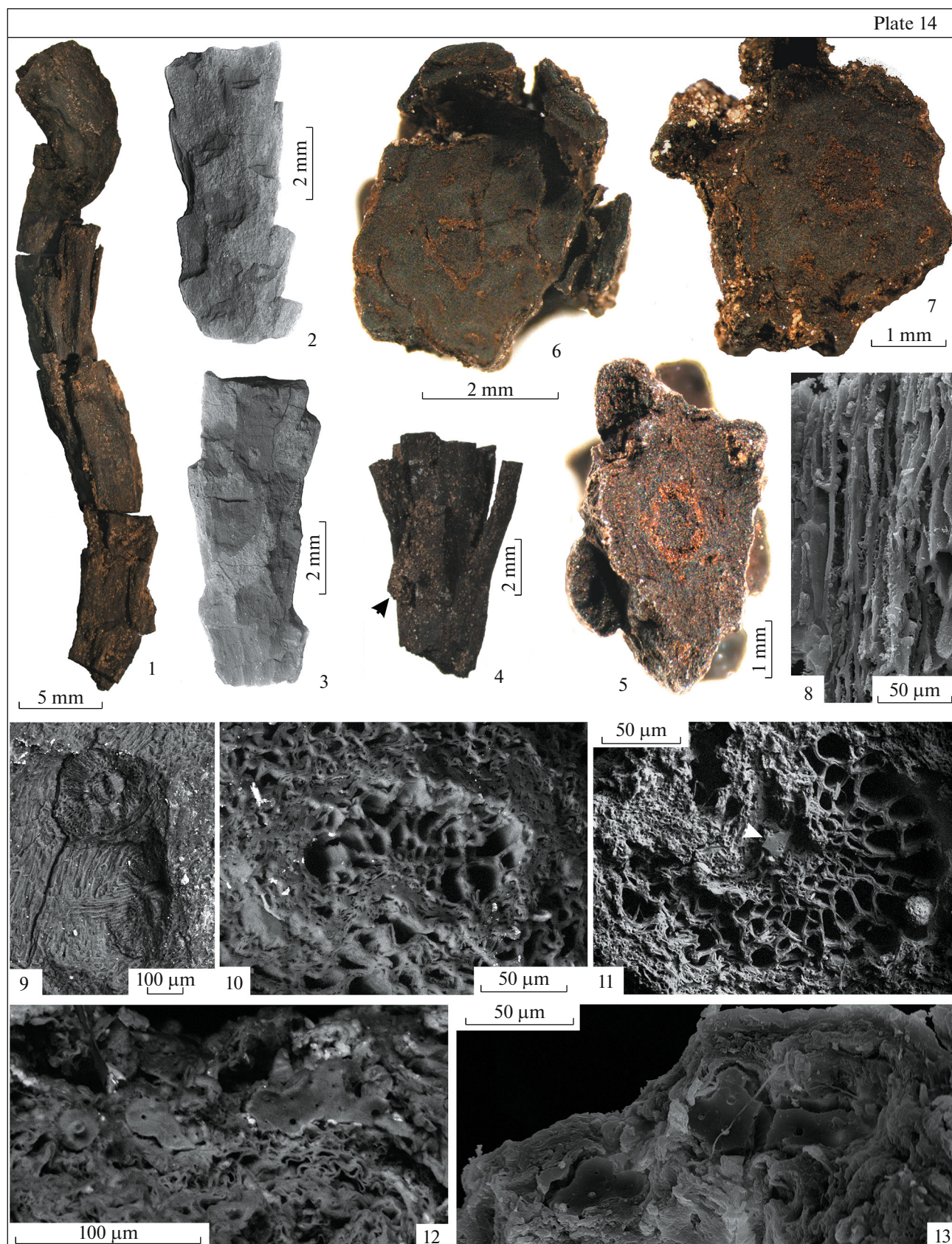
Until recently, anatomically preserved stems of Mesozoic Osmundoideae predominantly were grouped into fossil genera *Millerocaulis* Erasmus ex Tidwell, *Ashicaulis* Tidwell, *Osmundacaulis* C.N. Miller, and *Aure-*

alcaulis Tidwell et L.R. Parker (Miller, 1967, 1971; Tidwell, 1986, 1994; Tidwell and Parker, 1987; Tidwell and Pigg, 1993). At present, some researchers do not recognize the genus *Ashicaulis*, regarding it as a junior synonym of *Millerocaulis* (Vera, 2008; Bomfleur et al., 2017). Also, representatives of *Millerocaulis* and *Ashicaulis* with heterogeneous sclerenchyma rings recently have been transferred to extant genera, and *Aurealcaulis* is considered as a subgenus within the extant genus *Plenasium* C. Presl (Bomfleur et al., 2015, 2017). In the latter work, fossil species with three sclerenchyma masses in the outer cortex of petiole bases were placed in the genus *Osmundastrum*, to which we provisionally assign the species from Mikhailovskii Rudnik.

Thus, the major part of fossil osmundaceous species established on the basis of anatomically preserved stems, including Triassic and Jurassic species, has recently been placed in extant genera. In the authors opinion, this situation and, taken as a whole, placing into extant genera of pre-Cenozoic fossil species studied by isolated organs, is not entirely appropriate. For the correct assignment of a species to a particular genus, it is necessary that all key characters of the genus were established for this species. This is especially important when in an extant genus are included fossil species, the degree of knowledge of which is significantly lower than the degree of knowledge of extant representatives of this genus,—since in this case there is always the danger of involuntary substitution of the original concept of natural comprehensively characterized extant genus by the concept of formal fossil taxon,—up to the actual transformation of extant taxon into organ-genus. Such substitution inevitably leads to devaluation of the extant genus, associated with a significant expansion, uncertainty and instability of its framework, and adversely affects the use of this taxon in various reconstructions (phylogenetic, paleogeographic, etc.).

The delimitation of genera of extant Osmundaceae is based to a large extent upon sterile and fertile foliage characters, which for fossil species established on the basis of stems with preserved anatomical structure, are in most cases unavailable; connection of these stems with sterile and fertile fronds is known only in isolated cases (Yang et al., 2010). The assignment of such species to extant genera can only be based on the assumption that the correlation between the types of anatomical structure of stems and the types of sterile and fertile fronds in geological past was essentially the same

Fig. 2. *Osmundastrum gvozdevae* sp. nov., holotype PIN, no. 5173/70, SEM: (a) petiole base with completely developed abaxial arch and lateral masses (marked by grey arrows), masses in the adaxial concavity of vascular bundle are well-developed (marked by black arrows); in the inner cortex, two lateral masses and small abaxial mass appear (indicated by white arrows); (b) petiole base with maximally developed sclerenchyma masses in the inner cortex (marked by white arrows), sclerenchyma masses in the adaxial concavity of vascular bundle are indicated by black arrow, lateral masses in the outer cortex are indicated by grey arrows, the abaxial arch is not preserved; (c) fragment of petiole base with stipular wing of neighboring petiole base, adjacent to it from above and comprising large oblong sclerenchyma mass and smaller masses (marked by white arrows); (d) fragment of stipular wing with oblong sclerenchyma mass (marked by white arrows).



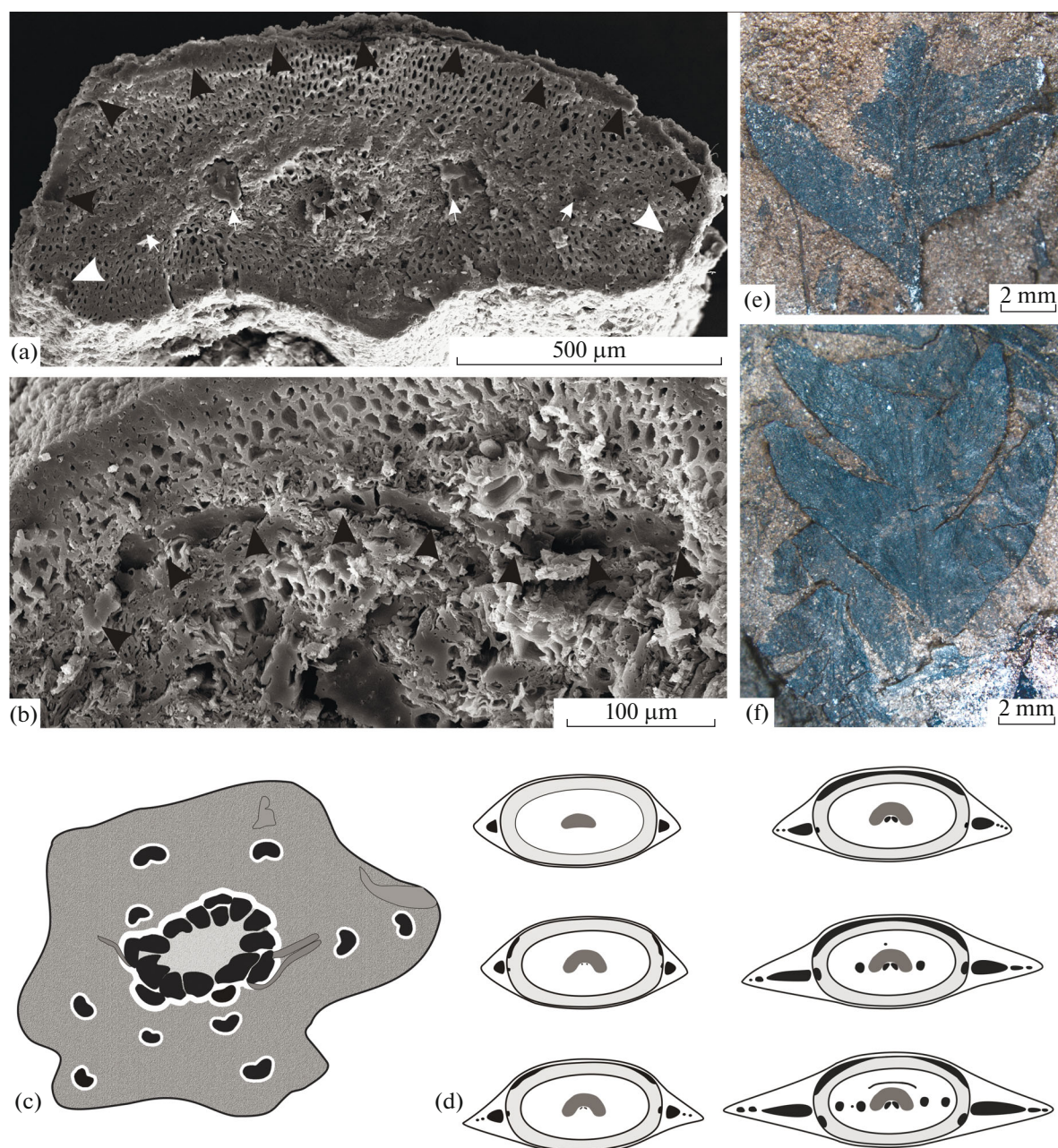
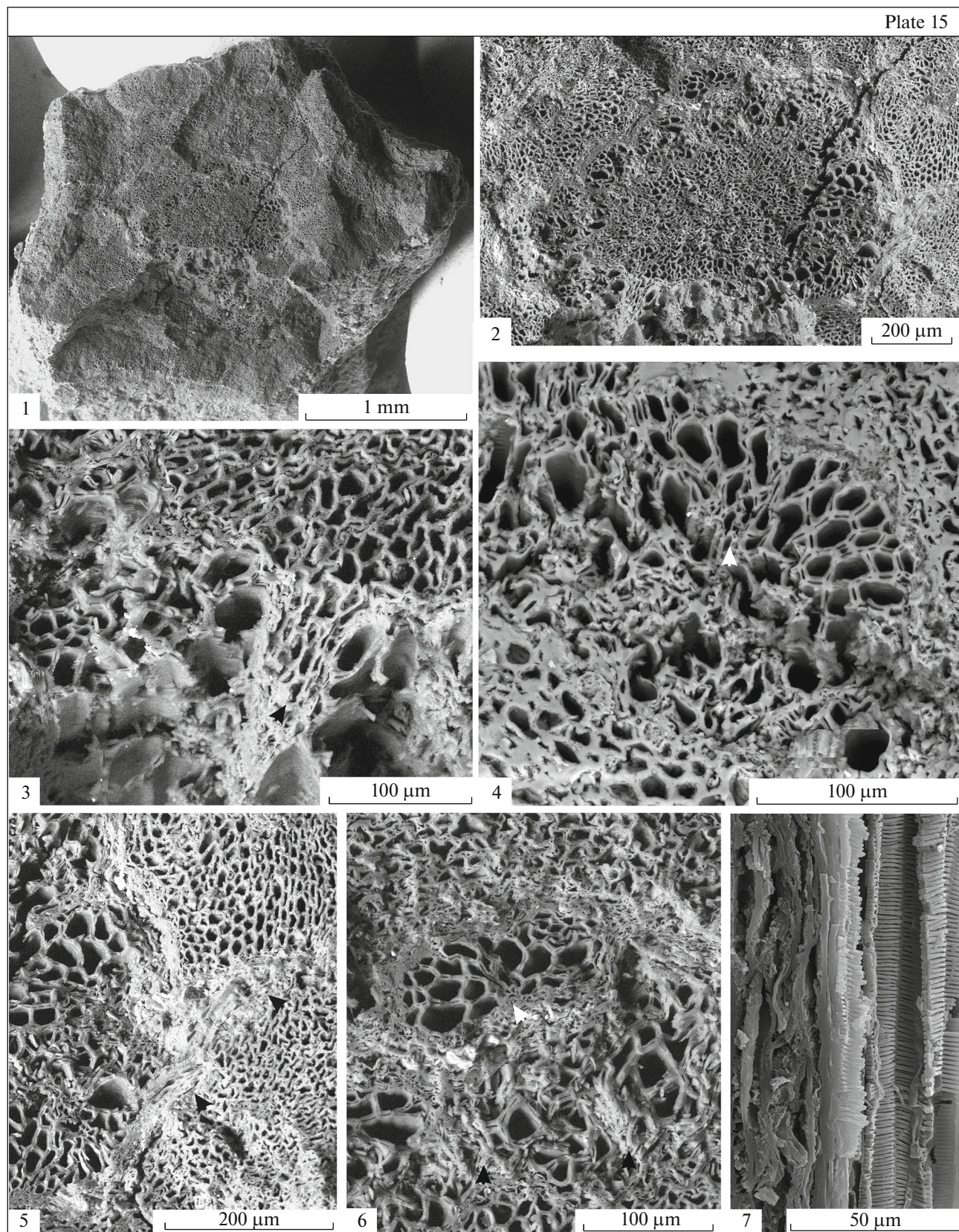


Fig. 3. *Osmundastrum gvozdevae* sp. nov. (a–d) and fragments of fronds *Cladophlebis* sp. (e, f): (a, b) holotype PIN, no. 5173/70, SEM: (a) petiole base with completely developed lateral sclerenchyma masses in the inner cortex (marked by small white arrows), abaxial arch in the outer cortex is well-preserved (marked by black arrows), lateral masses in the outer cortex are indicated by large white arrows; (b) fragment of petiole base with well-developed abaxial sclerenchyma mass in the inner cortex (marked by black arrows); (c) schematic drawing of the transverse split of stem, figured on Pl. 15, Fig. 1: pith is shown in mottled light grey, outer cortex is mottled dark grey, root traces are solid grey, xylem of vascular bundles is black, collapsed tissues of phloem, pericycle, endodermis, and inner cortex are white; (d) schematic reconstruction of changes in the structure of petiole base in *Osmundastrum gvozdevae* sp. nov., successive cross sections from basal to distal petiole parts: sclerenchyma masses are shown in black, vascular bundle is dark grey, outer cortex is light grey; (e, f) fragments of fronds *Cladophlebis* sp.: (e) ex. PIN, no. 5173/75; (f) ex. PIN, no. 5173/76.

Explanation of Plate 14

Figs. 1–13. Stems of *Osmundastrum gvozdevae* sp. nov.: (1, 6, 7, 11–13) holotype PIN, no. 5173/70: (1) fragment of stem with partly preserved petiole bases; (6, 7) transverse splits, orange-colored areas correspond to the xylem of vascular bundles; (11) petiole base departing from stem, leaf trace with bifurcating protoxylem group and small adaxial sclerenchyma mass (marked by arrow), SEM; (12, 13) developing sclerenchyma masses in stipular wings at relatively small distance from stem, SEM; (2) paratype PIN, no. 5173/71, stem fragment, petiole bases are not preserved, SEM; (3, 5, 8–10) paratype PIN, no. 5173/72: (3) stem fragment, petiole bases are not preserved, SEM; (5) transverse split, orange-colored areas correspond to the xylem of vascular bundles; (8) cells of peripheral part of pith on the longitudinal split, SEM; (9) pair of roots, departing from the stem, SEM; (10) middle part of the outer cortex, leaf trace with single protoxylem group, SEM; (4) ex. PIN, no. 5173/74, fragment of stem with partly preserved petiole bases and large dichotomizing root (marked by arrow).



Explanation of Plate 15

Figs. 1–7. Stems of *Osmundastrum gvozdevae* sp. nov., SEM: (1–3, 5–7) paratype PIN, no. 5173/72: (1) transverse split of stem; pith, stele, and cortex are visible; (2) detail of Fig. 1, pith and stele; (3) complete leaf gap, indicated by arrow; (5) leaf trace, departing from the stele, with pair of root traces (marked by arrows) diverging from it; (6) endarch leaf trace in the inner cortex immediately after departure from the stele; (7) longitudinal split through the central part of stem, tracheids of vascular bundle with scalariform bordered pits; on the left, collapsed cortical cells are visible; (4) holotype PIN, no. 5173/70, one of the bundles of vascular cylinder, arrow indicates protoxylem strand in mesarch position.

as is typical for extant species of these genera. Although there are indications that some extant types of sterile and fertile fronds in osmundaceous ferns existed already in the Late Triassic (Miller, 1971; Phipps et al., 1998; Taylor et al., 2009), there are no proofs that their correlation with corresponding types of stem anatomical structure was similar to what is known for extant representatives. It can be expected that this correlation in its modern form was typical for relatively young (Cenozoic, possibly Cretaceous) Osmundaceae, but in more ancient osmundaceous ferns, picture of correspondences could be much more complex; probable is the presence of taxa with a mosaic distribution of characters at level of archaic diversity. The situation is further complicated by the fact that anatomical features of fossil osmundaceous stems are available for study also not in full measure, some important characters (type of stele, presence/absence and degree of development of leaf gaps) change during ontogeny, and on limited fossil material it is often impossible to ascertain, whether we dealt with mature or juvenile form. To include fossil species of osmundaceous stems, the concept of an extant genus is reduced to a combination of a few distinguishing anatomical stem features, typical for extant representatives of this genus. The study of the historical development of extant osmundaceous genera changes to tracing into the past, down to the Triassic, of these combinations. The problem of the validity of such an approach is very acute and is not limited to questions of classification of the osmundaceous ferns. In the current situation, perhaps it would be better to use formal genera for assigning fossil species of stems of Osmundaceae (as is customary at present for assigning fossil species of their foliage), or at least to consider these species not as legitimate species of an extant genus, but as associated species, formally not included in the genus framework, and thus not affecting the concept of the genus.

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