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Moresnetia-LIKE PLANTS FROM THE UPPER DEVONIAN OF MINUSINSK BASIN, SIBERIA

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Abstract: Siberian plants previously assigned to *Moresnetia* are separated in a new genus *Lenlogia* with cupule-like clusters of paired and proximally fused sporangia. The latter feature distinguishes the new genus from *Protopteridophyton* Li et Hsu. Its relation to progymnosperms is discussed.

Сибирские растения, ранее относимые к *Moresnetia*, выделены в новый род *Lenlogia*, имеющий куполовидные собрания спаренных и проксимально сросшихся спорангиев. Последняя особенность отличает новый род от *Protopteridophyton* Li et Hsu. Рассматриваются его возможные связи с прогимноспермами.

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In 1959 Ananiev [1] assigned dichotomous axes with distally clustered appendages from the Upper Devonian of Minusinsk Basin, Siberia, to *Moresnetia zalesskyi*, a species described by Stockmans from the stratigraphically equivalent beds in Belgium [9]. Stockmans has provided Ananiev with a few specimens from the original material for comparison with the Siberian fossils. These materials are now deposited in the Tomsk University Museum.

The putative *Moresnetia* axes from Siberia were accompanied by a reniform body reported as the first Devonian seed [2].

In 1986 Professor Ananiev courteously provided us with an opportunity to examine his specimens from Siberia and Belgium. Our impression was that they belonged to a plant of pteridophytic affinities.

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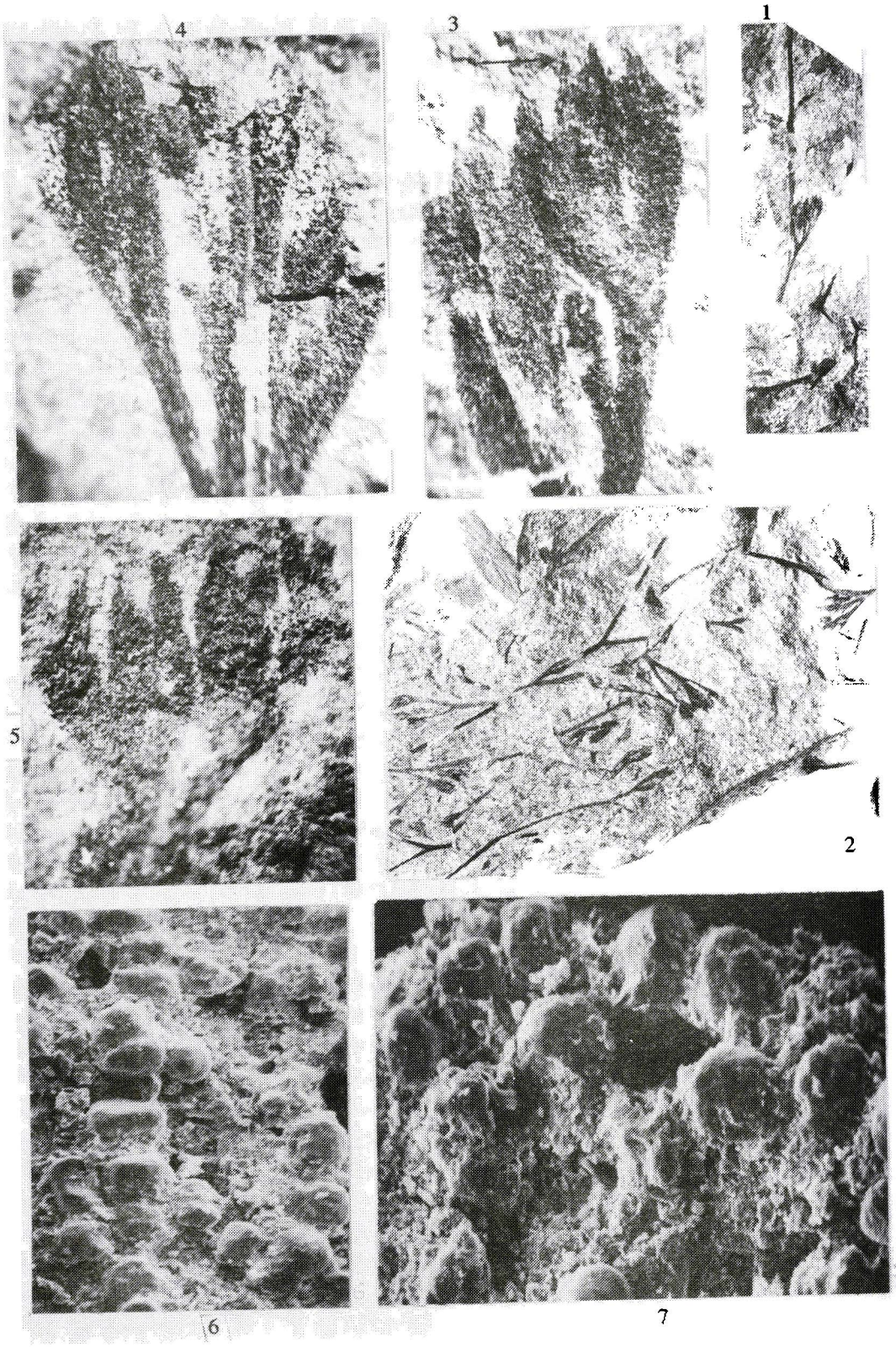

PLATE I

At the same time we thought the Siberian and Belgian fossils similar enough to be assigned to the same genus. Our paper was reviewed by S. E. Scheckler who informed us of then yet unpublished *Moresnetia* seeds [3]. These findings urged us to re-examine our material which eventually was assigned to a new genus.

Lenlogia Krassilov et Zakharova, gen. nov.

Name. After Lennyj Log, the type locality.

Type species. *Moresnetia kryshtofovichii* Radczenko in Petrosyan [7], Lennyj Log, Minusinsk Basin, Upper Devonian.

Diagnosis. Forked axes with protostele of scalariform and annular tracheids, bearing condensed clusters of sympodially branched appendages bearing terminal bisporangiate synangia. Sporangia erect, fused up to 2/3 their length. Spores of one kind, smooth, trilete.

Lenlogia kryshtofovichii (Radczenko) comb. nov.

Pl. I, figs. 1-7; Pl. II, figs. 1-4; Pl. III, fig. 5

Lectotype: No. 40-92, Tomsk University Museum, figured in [1] plate 18, fig. 1, [2], plate 7, fig. 1*a*.

Moresnetia zalesskyi: Ananiev, 1959 [1], p. 31, Pl. 18, fig. 1; Ananiev, 1963 [2], p. 340, Pl. 7, fig. 1*a*, *b*.

Moresnetia kryshtofovichii: Radczenko in Petrosyan, 1959 [7], p. 96, Pl. 1, figs. 1-3; Radczenko in Lepekhina et al., 1962 [5], p. 132, Pl. 20, figs. 1-6.

Diagnosis. As for the genus.

Description. Specimens 40-92, 40-94, 40-163 and 50-3 from Ananiev's collection are sandstone slabs covered with impressions and compressions of longitudinally striated dichot-

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KEY TO PLATE I

Fig. 1. *Lenlogia kryshtofovichii* - axis with a sporangial cluster on the overtopped side branch, No. 40-163, ×1.
Fig. 2. Several fertile axes. Lectotype, No. 40-92, ×1.
Fig. 3. Terminal cluster with two bisporangiate synangia, enlarged from fig. 2, ×8.
Fig. 4. Terminal cluster with poorly preserved sporangia, enlarged from fig. 2, ×8.
Fig. 5. Cluster with synangia on each of the secondary lobes, ×8.
Figs. 6, 7. Spores protruding from sporangial wall, SEM, ×200 and 350.

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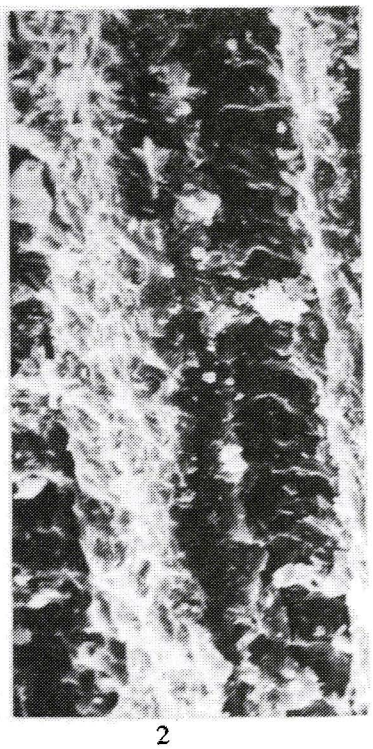

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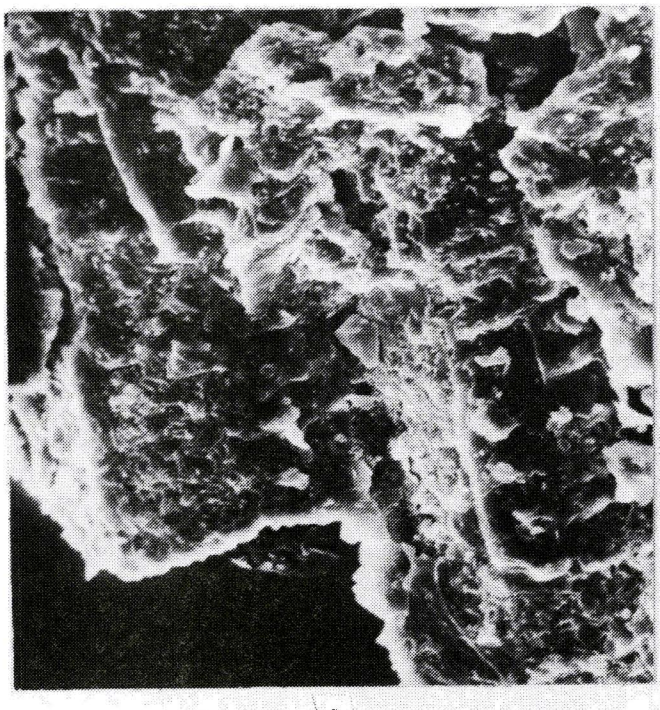

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PLATE II

omously branched axes about 1 mm thick. Branching appears as unequal dichotomy. One of the longest axes shown in Pl. I, fig. 5 is 1.1 mm wide at the proximal end, expanding slightly toward the point of dichotomy. One arm extends fairly straight for 65 mm, but shows a bulge which suggests branching at an angle to the bedding plane.

Some of the axes show a central strand of vascular tissue about 0.5 mm thick. Several fragments have been peeled along the strand and mounted for SEM. They show tracheids with spiral and annular thickenings (Pl. II, figs. 1-4).

Similar axes in Pl. I, figs. 1, 2 bear cupule-like clusters resulting from four to five rapid dichotomies. In a single specimen the cupule cluster is borne on a short side branch overtopped by a much longer axis more that 40 mm long (Pl. I, fig. 1). More typically the cupule clusters occur on unequal arms of the terminal dichotomies forming dichasial "inflorescences." The clusters have a sympodial structure resulting from successive overtopping of acroscopic appendages. Each or only the inner appendages bear sporangia (Pl. I, figs. 3-5). The appendages are striated like the main axis with conspicuous dots of hair bases.

The sporangia are about 3 mm long, 1.2 mm wide, terminal, erect, born in pairs, fused except at acute apices in bisporangiate synangia. In SEM the sporangia show spores protruding from their partly decayed walls. Spores are globose, smooth, proximally convex, with triradiate scar.

Remarks. Russian investigators have unanimously placed this material in *Moresnetia*, but differed in the species assignments. While Ananiev [1, 2] has considered his specimens from Lennyj Log conspecific with the Belgium fossils, Radczenko [5, 7] has left in *M. zalesskyi* a few rather featureless specimens from Ananiev's collection while transferring all the cupuliferous shoots to his new species *M. kryshtofovichii*. At the same time Petrosyan [7] has erected the third species *M. sibirica* for terete dichotomous axes. If nonconspecific with *M. zalesskyi*, the Siberian shoots have to be placed in *M. kryshtofovichii* as a valid binominal.

Scheckler [3], after examining a few specimens from Ananiev's collection deposited in the British Museum of Natural History, has concluded that they, though similar to *Moresnetia*, should be kept separate from this genus because other Devonian genera also differ from it in not very conspicuous details.

In *Moresnetia* asymmetric cupules are borne on unequally forked terminal branches. They contain up to four ovules which are attached in oblique vertical series. Typically the ovules are borne on the inner lobe of the third tangential division while the outer lobe divides once more, producing acute or notched tips (fig. 2). The ovules are much shorter than sterile lobes. *Lenlogia* is similar to *Moresnetia* in unequal division of fertile clusters resulting in sympodial structures

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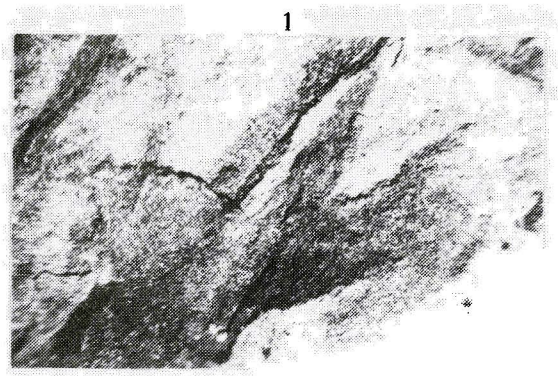
KEY TO PLATE II

Fig. 1. Vascular tissue from the protosele of the axis, N40-94, SEM, ×400.
Figs. 2-4. Vascular elements with spiral and annular thickenings, SEM, ×1000.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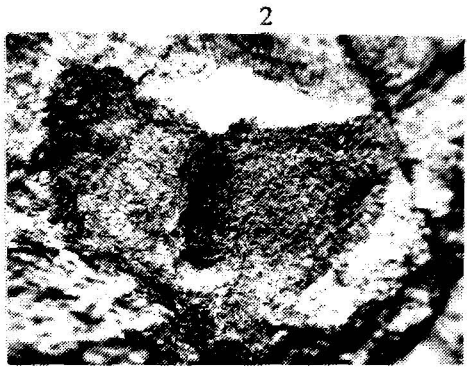
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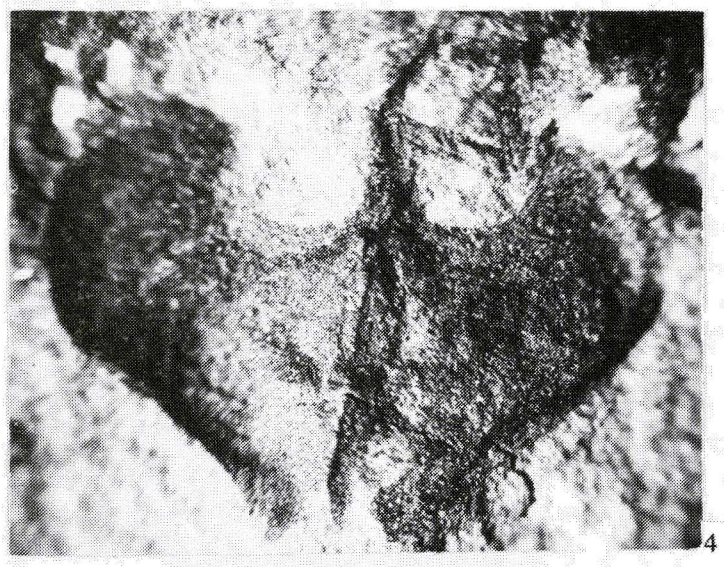
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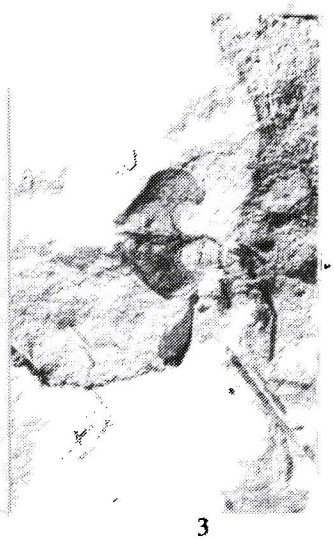
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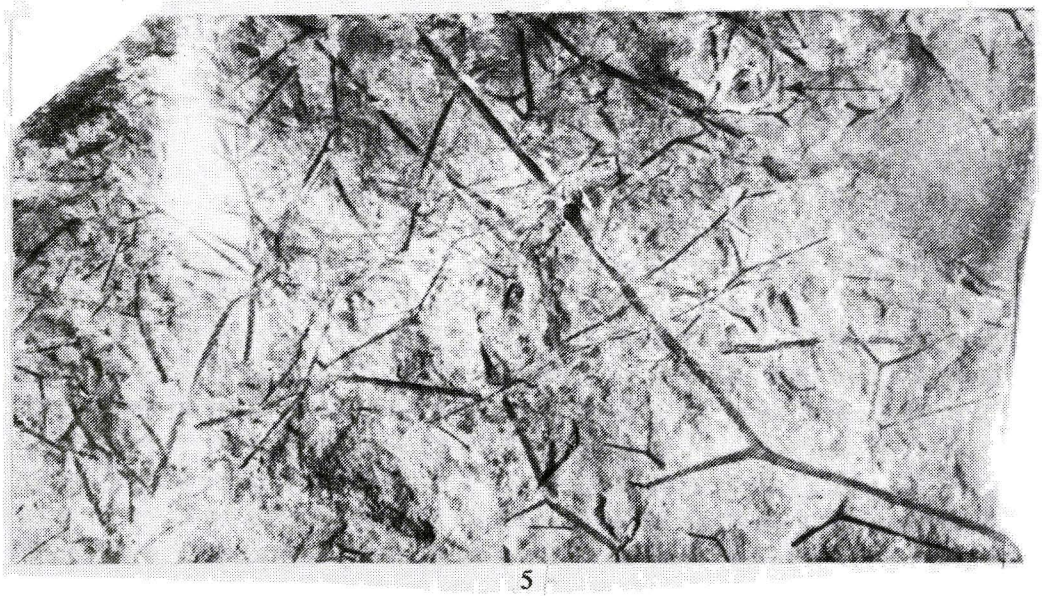
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PLATE III

different from the more radially symmetrical arrangement in other Devonian seed plants, *Archaeosperma*, *Hydrosperma* and *Xenotheca*. However, in *Lenlogia* the cluster appendages bear bisporangiate sporangia comparable to those of extant *Tmesipteris*. Among the Devonian pteridophytic plants, *Protopteridophyton* is similar in having terminal clusters of paired sporangia, which are not fused, however.

RENIFORM BODIES

Ananiev found a reniform body in association with *Moresnetia*-like shoots from the Lennyj Log locality. He described it as the first Devonian seed [2]. This finding was not mentioned, however, in either of the subsequent records of Devonian seeds.

Petrosyan [5] has assigned similar reniform bodies to *Condursia* which she interpreted as a spore-bearing structure. Actually Stockmans introduced *Condursia* together with *Moresnetia* but without any implications of affinity.

Ananiev's specimen No. 40-201 (Pl. III, figs. 3, 4) occurs on a slab covered with *Lenlogia* shoots. It is 4 mm long, 8 mm wide, flat, with a thick median ridge flanked by two symmetrical lobes. On the concave side of the body the median ridge forms a collar-like protrusion with a thin flexible axis issuing from it. On the opposite end a slightly thicker axis extends from the incised base of the body. The lobes are recurved, distally pointed, thickened along the margin showing distinct arcuate lines along the concave margin.

Another similar but crumpled body was noticed among the crowded shoots on the same slab (Pl. III, fig. 3). A short axis arises from the middle of its concave side.

A smaller reniform body of the same type occurs on slab No. 40-94, also in close association with *Lenlogia* shoots. It is only 4 mm wide, less cordate, nearly triangular, with finely pitted surface (Pl. III, fig. 2). The median ridge is like in the previous specimens, 0.8 mm wide, but even more prominent, consisting of shiny coal. On the concave side there is a collar-like depression but without any issuing organ, while on the opposite end the medial ridge gives off a short tapering axis extending slightly beyond the wing.

Their interpretation as seeds still has to be confirmed. At the same time they resemble

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KEY TO PLATE III

Lenlogia kryshtofovichii and associated reniform bodies:

Figs. 1, 2. Reniform bodies preserved among the *Lenlogia* axes on specimens No. 40-94 and 40-21, ×10.

Figs. 3, 4. Reniform body showing well-developed lobes, median ridge with a collar-like protrusion and the issuing axis (Ananiev's "seed"), No. 40-201, ×2 and 10.

Fig. 5. Dichotomous axes and a reniform body (arrow), ×1.

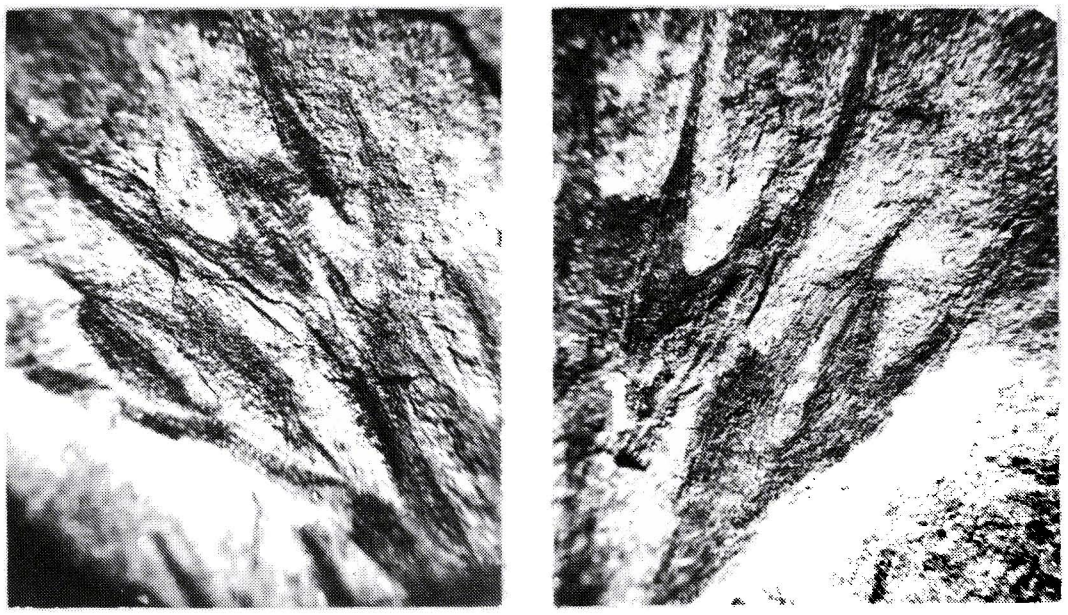

Fig. 1. *Moresnetia zalesskyi* Stockmans, Belgian specimen No. 50-3, cupules, the left one showing an ovule, ×10.

fern prothallia, which are typically reniform or cordate, flat, membranous, with an apical group of meristematic cells forming a crescent-shaped "notched" meristem which is fairly distinct from the rest of the prothallial tissue. In fossil state the notched region of densely protoplasmic cells might appear as the above-mentioned crescent-shaped areas of the reniform objects. A medial body of the latter is then positioned near the apex as archegonia in many pteridophytic plants the sporelings of which emerge through the expanded archegonium center. The primary root might grow through the prothallial tissue as in extant horsetails.

CONCLUSIONS

We conclude that Siberian species previously referred to *Moresnetia* produced sporangial clusters strikingly similar to the cupular structures of primordial ovules [4, 8].

Some interesting possibilities arise from this comparison. First, the primeval seed plants or some of them could originate from herbaceous pteridophytic progenitors remotely if at all related to progymnosperms. Further, if precursory to ovules, the *Lenlogia*-type dwarf shoots might form seed coats from the peripheral and a nucellus from the fused median sporangia. A derivation from a pair of fused sporangia—rather than a single sporangium—seems consistent with the massiveness and elaborate apical structures of the early nucelli.

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