Bulletin 30

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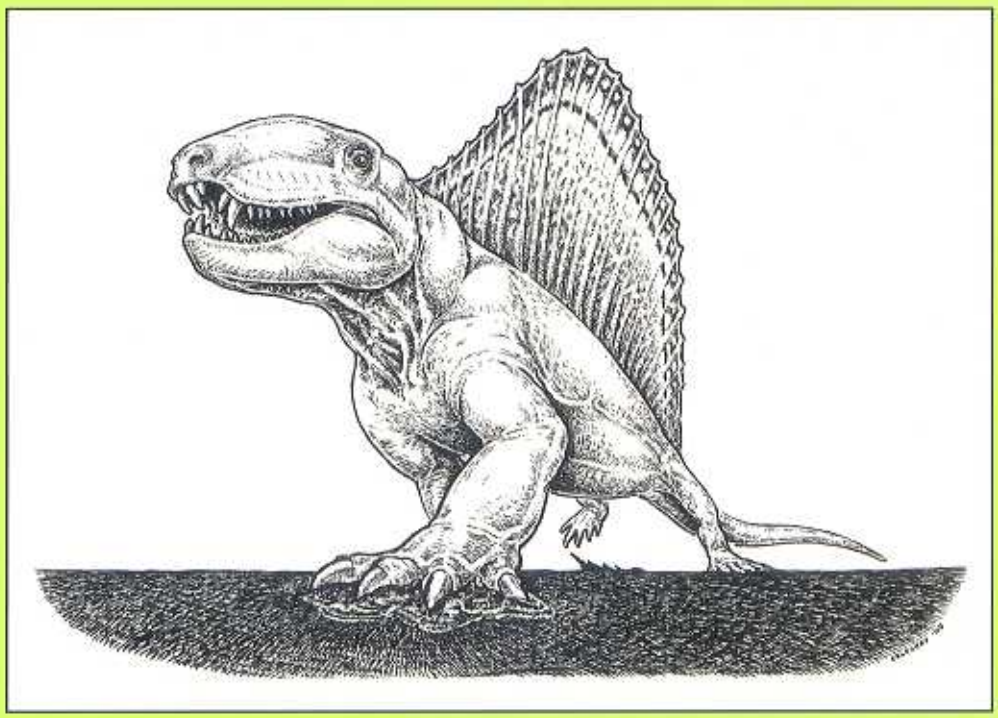
The Nonmarine Permian



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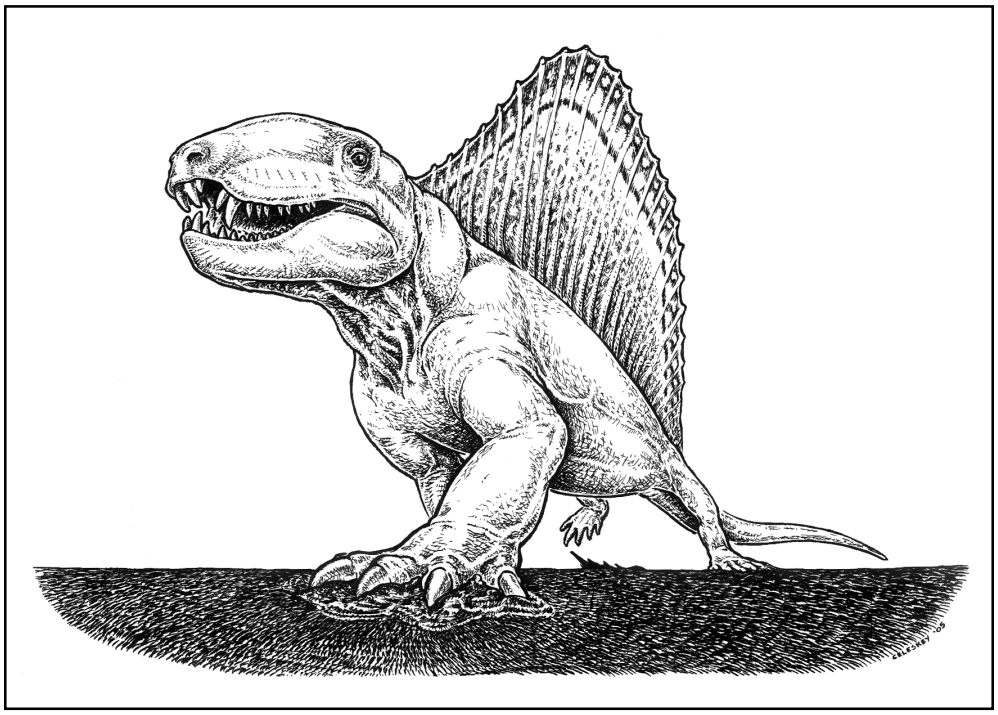

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UNIQUE VYAZNIKI BIOTIC COMPLEX OF THE TERMINAL PERMIAN FROM CENTRAL RUSSIA, AND THE GLOBAL ECOLOGICAL CRISIS AT THE PERMO-TRIASSIC BOUNDARY

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A new, unique and diverse terrestrial biotic complex of the terminal Permian was recently discovered in the Vyazniki Town (Vladimir Region of Central Russia) (Fig.1). Variegated Permian clays and sands were discovered in Vyazniki Town for the first time in 1841 by R. J. Murchison during his expedition to European Russia (Murchison et al., 1845). At the same time, Murchison also found Permian ostracods and bivalves there. The vertebrate locality Vyazniki was discovered in 1951, and during 1952, 1955 and 1956 was excavated by expeditions of the Paleontological Institute of the USSR AS headed by B.P. Vyushkov (Efremov and Vyushkov, 1955). This locality yielded a much material, including fishes, amphibians and reptiles. Thus, a new Late Permian vertebrate fauna in Central Russia was discovered.

After a long period, A.G. Sennikov, V.K. Golubev and V.V. Bulanov (Paleontological Institute of the RAS, Moscow) re-discovered the Vyazniki locality and collected new vertebrate materials during 1999-2003. Rich and diverse fossils were found in Vyazniki Town and its vicinity at a number of localities of Late Permian age during 2003-2004. Apart from vertebrates, this complex also includes macrofloral remains, spores and pollen, bivalves, ostracods, conchostracans and insects. All fossils were found in sands and clays of alluvial genesis. These deposits were accumulated in a number of channel and abandoned channels (or oxbow-lakes) of the spacious flood-plain of a great river system directed from the east to the west, which is from the Ural mountains to the plain.

The Vyazniki end-Permian biotic complex has no analogues in other continents and is the last, so far unknown stage in the history of the Late Permian continental biota. The tetrapod assemblage of Vyazniki type is known also from the Purly locality (Nizhny Novgorod Region), and perhaps from a few other Upper Permian localities in the territory of European Russia (Ivakhnenko and al., 1997; Golubev, 2000; Ivakhnenko, 2003). On the Russian platform the Vyazniki faunistic stage is situated between the Late Permian Sokolki and Early Triassic Vokhmian (Early Vetlugian) stages (Sennikov, 1995, 1996; Ivakhnenko and al., 1997; Golubev, 2000) (Fig.2). The eastern European Sokolki vertebrate fauna including pareiasaurs and gorgonorpsians is similar to the end-Permian faunas of South Africa and other continents. The Vokhmian fauna is correlated to lystrosaurid-proterosuchid faunas of the beginning of Early Triassic in other continents.

The Vyazniki community demonstrates a transitional nature between Permian and Triassic communitiess. The list of Vyazniki tetrapod fauna includes the temnospondyl *Dvinosaurus egregius* Shishkin, Microsauria (?) fam. indet., a kotlassimorph Karpinskiosauridae gen. indet., the parareptile *Elginia* sp., the anthracosaurs *Bystrowiana permira* Vjuschkov and *Uralerpeton tverdochlebovae* Golubev, the thecodont *Archosaurus rossicus* Tatarinov (Fig.3), an anomodont Dicynodontidae gen. indet., and the therocephalians *Moschowhaitsia vjuschkovi* Tatarinov and Moschorhinidae gen. indet. (Fig. 4). Most important was the disappearance of the pareiasaur-gorgonopsian coadaptive pair as dominant large herbivore-carnivore and appearance of new top predators (ultimate consumers), the proterosuchids (Fig.5). The Vyazniki community documents the beginning of the major faunal replacement at the Permo-Triassic boundary and during the Triassic, which is the replacement of therapsids by archosaurs. By its food chain structure, the Vyazniki terrestrial community turns to be the first thecodont-dicynodont chain. In this respect, the Vyazniki terrestrial community is more similar not to Late Permian, but to Triassic communities. The anthracosaur *Bystrowiana* is the first record of bystrowianids, relic chroniosuchians typical of the Triassic. Dvinosaurs, kotlassiomorphs, chroniosuchids, elginiids, therocephalians and dicynodontids are typical Upper Permian elements in the Vyazniki assemblage (Golubev, 2000).

The Vyazniki fishes include the hybodont sharks *Wodnika* sp. and actinoterygians *Saurichthys* sp. (Lozovsky and Yesaulova, 1998). The former is found in the Zechstein of Germany, and the latter is typical of the Triassic faunas. Diverse paleonisciforms *Geryonichthys* (?) sp., *Mutovinia stella* Minich, *Mutovinia* sp. nov., *Toyemia blumentalis* A. Minich, *Toyemia* sp., *Isadia* (?) sp. (A.V.Minikh, pers. comm.) belong to the Late Permian (Late Tatarian) ichthyoassemblage.

Fossil insects from Vyazniki are under study. This insect assemblage including grylloblatid Tomiidae demonstrates its most terminal Permian position, probably close to the Permo-Triassic boundary (D.E. Shcherbakov, pers. comm.).

Ostracods from Vyazniki (identified by I. I. Molostovskaya) include *Clinocypris* cf. *C. elongata* Schneider, *Clinocypris* sp., *Darwinula* (?) *sima* Mishina, *D.* (?). *accuminata* Belousova, *D.* (?). *regia* Mishina, *D.* (?) *abscondita* Mishina, *Darwinuloides* ex gr. *svijazhicus* Sharapova, *Gerdalia* ex gr. *G. rixosa* Mishina, *G.* cf. *G. triassiana* Belousova, *G.* ex gr. *G. analoga* Starozhilova, *G. wetlugensis* Belousova, *Gerdalia* sp., *Marginella* (?) sp., *Nerechtina* cf. *plana* Mishina, *Suchonella* cf. *S. posttypica* Starozhilova, *S.* ex gr. *S. typica* Spizharskyi, *Suchonellina bulloida* (Mishina), *S.* cf. *S. anjugensis* (Mishina), *S.* ex gr. *S. anjugensis* (Mishina), *S. dispinosa* (Mishina), *S.* ex gr. *S. dispinosa* Mishina), *S.* ex gr. *S. trapezoida* (Sharapova), *S. perelubica* (Starozhilova) (= *S. alija* (Mishina), *S. pseudoinornata* (Belousova) (= *S. postparallela* (Mishina)), *Wjatkellina* (?) *pseudoobliqua* (Belousova), *W. fragilina*

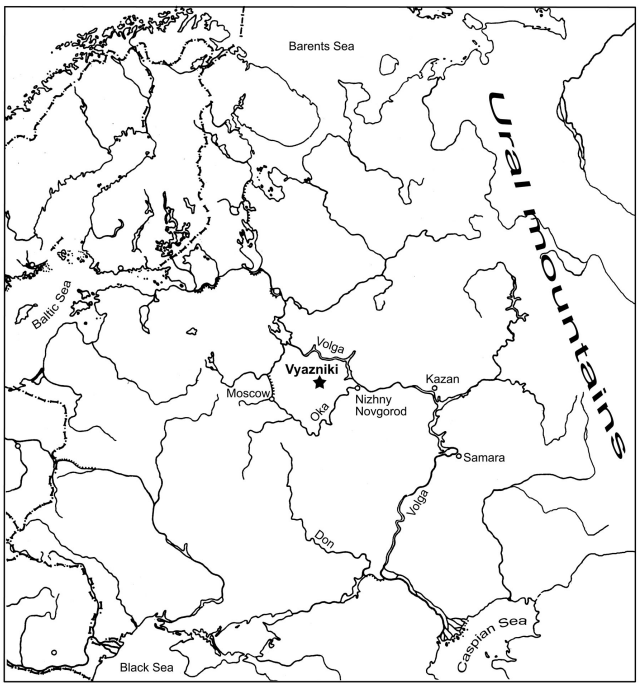

FIGURE1. Geographical position of the Late Permian Vyazniki locality.

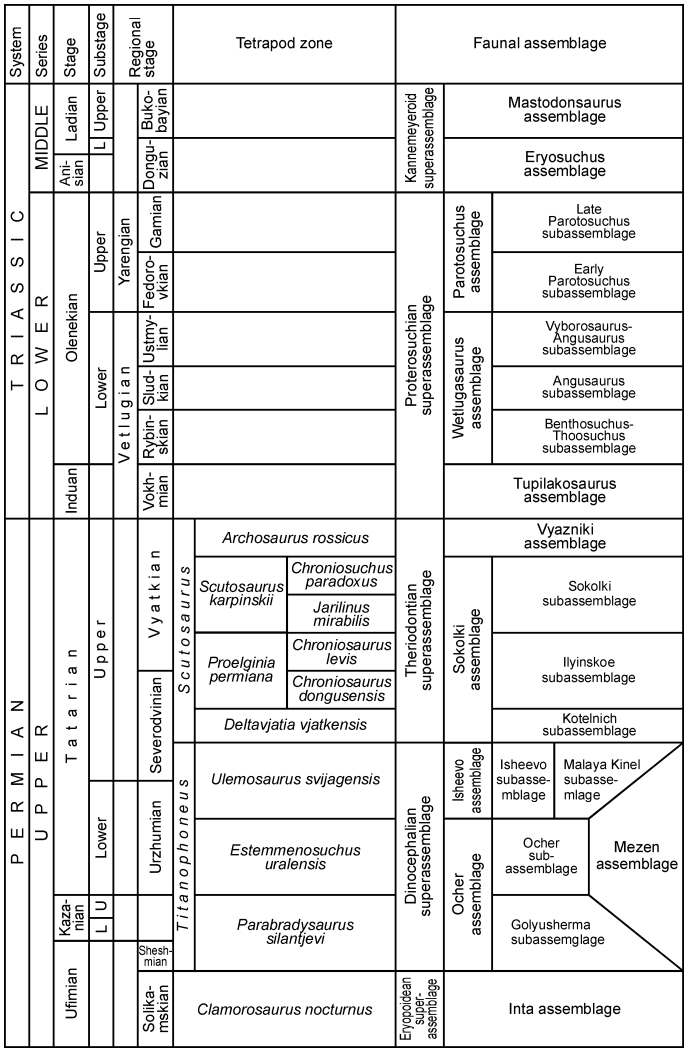

FIGURE 2. Permian and Triassic tetrapod zonation and assemblages of Eastern Europe.

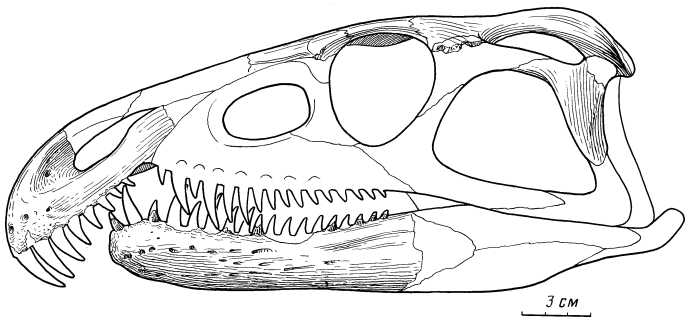

FIGURE 3. Reconstruction of the skull of the proterosuchid *Archosaurus rossicus* from the Vyazniki locality.

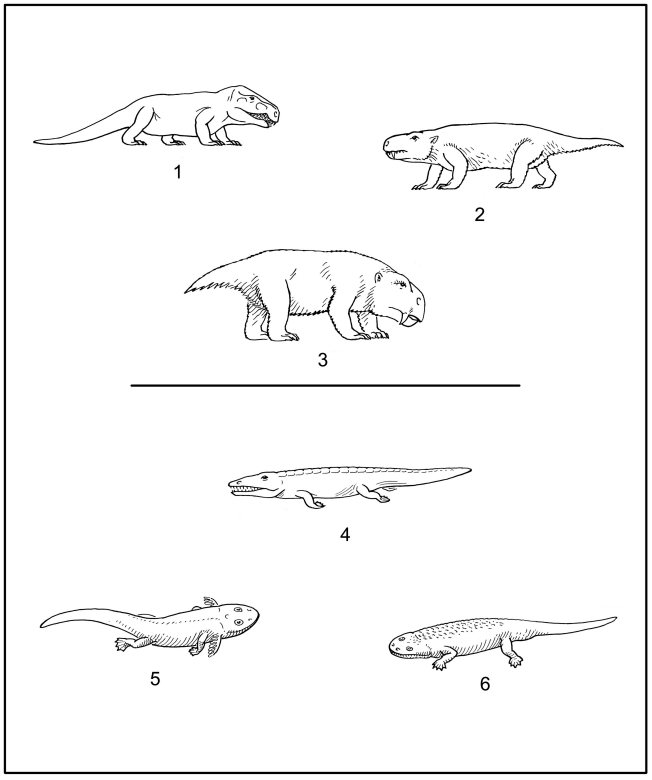

FIGURE 4. The most important components of the Vyazniki tetrapod fauna: 1) proterosuchid *Archosaurus*, 2) therocephalian *Moschowhaitsia*, 3) dicynodontid, 4) chroniosuchian *Bystrowiana*, 5) temnospondyl *Dvinosaurus*, 6) karpinskiosaurid.

(Belousova), *W. vladimirinae* (Belousova), and *W.* cf. *W. vladimirinae* (Belousova). The composition of the Vyazniki ostracod assemblage is mostly characteristic of the Triassic, but includes few Permian elements (Golubev et al., 2005).

The following conchostracans from Vyazniki were identified by N.I. Novozhilov: Limnadiopseidae gen. nov., Lioestheriidae *Sphaerestheria* sp. nov., *Pseudestheria suchonensis* Novojilov, *Pseudestheria* sp. nov. 1, Pseudestheria sp. nov. 2, *Loxomicroglypta* sp. nov. and *Concherisma* sp. nov. This assemblage agrees with the Late Permian (Tatarian) age of the Vyazniki deposits.

Bivalves include *Palaeomutela oleniana* Amalitzky, *Palaeomutela plana* Amalitzky, *Palaeomutela* aff. *P. plana* Amalitzky, *Palaeomutela* cf. *P. solemyaeformis* (Netschajew), *Palaeomutela* (?) *concavocarinata* (Netschajew) and *Palaeomutela* sp. (V.V.Silantjev, pers. comm.). This bivalve assemblage is typical of the end-Permian (Tatarian) deposits of the Russian platform.

The Vyazniki macroflora is very special and diverse. The list of plants (identified by S. V. Naugolnykh) includes predominantly ferns: *Pursongia* sp., *Lepidopteris* (?) sp. nov., *Tatarina* sp., *Peltaspermum* sp. nov., but also arthrophytes *Neocalamites* cf. *N. mansfeldicus*, ginkgophytes *Sphenobaiera* sp. and conifers cf. *Ullmannia frumentaria* (Golubev et al., 2005). This macrofloral assemblage is new, so far unknown in Eastern Europe, similar to the West European (Zechstein) assemblage and terminal Permian in nature.

The rich Vyazniki palynocomplex is today under study, but also demonstrates terminal Permian characters (S.A. Afonin, pers.comm.).

New data on the Vyazniki uppermost Permian deposits and new transitional biotic complex does not support the hypothesis of the presence of a large gap in the continental sedimentation and in the history of life in Eastern Europe close to the Permo-Triassic boundary (Golubev, 2004). New data don't support the common opinion of a strong increase of aridity around this boundary. During the Late Tatarian, the climate was generally subhumid in Eastern Europe.

On the whole, the Vyazniki biotic complex and community structure demonstrate their transitional nature and present the last, so far unknown stage of the global ecological crisis at the Permo-Triassic boundary on the continents (Sennikov, 1995, 1996, 2004). At the base of this new information the scenario of global biotic crisis in the continental biota at this boundary exemplified by Eastern Europe may be suggested. The most complete Permo-Triassic stratigraphic succession

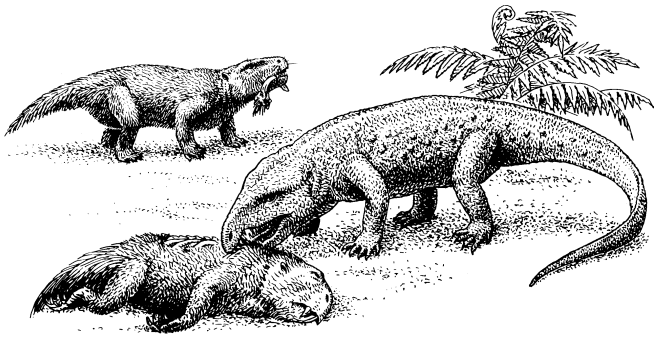

FIGURE 5. Life reconstruction of the Vyazniki community: proterosuchid *Archosaurus* and therocephalian *Moschowhaitsia* capturing a juvenile dicynodontid.

on the Russian platform presents a unique possibility for such reconstruction, as at least eight stages in the Late Permian and eight stages in the Early and Middle Triassic can be distinguished in the biotic history (Fig. 2). Major stages in the history of Eastern European continental communities are (Sennikov, 1996; Golubev, 2000):

1. Early Permian eryopoidean temnospondyl community of North American origin (Inta assemblage).

2. Typical Permian therapsid (theriodontian-dinocephalian) terrestrial and rhachitomous temnospondyl aquatic communities of the Late Permian (Ocher, Mezen and Isheevo assemblages).

3. Greatest tetrapod extinction at the Early-Late Tatarian boundary (at the end of the Guadalupian).

4. Transitional end-Permian theriodontian-pareiasaurian-dicynodontian (Sokolki) and the first thecodontian-dicynodontian (Vyazniki) terrestrial communities, as well as chroniosuchian (Sokolki and Vyazniki assemblages) aquatic communities.

5. Main biotic extinction at the Permo-Triassic boundary.

6. Post-crisis thecodontian-dicynodontian terrestrial (including scarce *Lystrosaurus*) and temnospondyl aquatic communities of the Early Triassic (Vetluga and Yarenga assemblages).

7. Typical Triassic thecodontian-dicynodontian terrestrial (including kannemeyeroids) and temnospondyl aquatic communities of the end of the Early and of the Middle Triassic (terminal Yarenga, Donguz and Bukobay assemblages).

The Permo-Triassic biotic transition was successive, gradual, and continuous, including a number of phases and mosaic in various groups. The maximum of mass extinction occurred at the Paleozoic-Mesozoic boundary both on the continents and in the seas (Sepkoski, 1978, 1979, 1984; Benton, 1985a,b). Such successive development of a biotic crisis during the Late Permian finished by mass extinction at the Permo-Triassic boundary and successive, lengthy post-crisis development and specialization of new Triassic groups, as well as reconstruction and diversification of the biotic complex composition and community structure suggests an adequate evidence of predominance of internal, biotic causes of this crisis, realized in destabilization, alteration and new stabilization of continental communities and ecosystems.

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