

## Occurrence of stegocephalians in the northeast of the European part of the USSR

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According to previous research by N. N. Yakovleyev, A. M. Zrirmunskii, A. N. Ryabinin, L. T. Lutunghin, and others, several outcroppings of a varicolored layer along the Vetluga, Sharzenga, and Luza Rivers are famous for repeated discoveries of stegocephalian remains.

In 1927, under the direction of the Geological Museum of the Akademiia Nauk, I investigated three localities situated south of one another: at the villages Pritykino and B. Sludka on the Vetluga river and at the village of Vahknyev on the Sharzenga River. Remains of labyrinthodonts collected in this vicinity appeared to be in an excellent state of preservation and to belong to new forms. On the basis of a complete skull from the Sharzenga River I established a new genus of labyrinthodont—*Benthosaurus*. Almost simultaneously A. N. Ryabinin described the new form *Wetlugosaurus* from the locality near Pritykino on the Vetluga River. In 1928 the Geological Museum again organized an expedition under my supervision for continuing the investigation of these localities. The expedition conducted excavations in the three localities mentioned above, also examined two others (Upper Luza River and the Shikhovo-Chirkovskii rock faults on the Vyatka

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River) and obtained about 2 tons of skeletal elements of labyrinthodonts in the stratum, among which are many skulls.

Except for the Shikhovo-Chirkovskii rock faults, the fauna of which was contained in Permian limestone, the remaining four localities were dated to one horizon and supposedly belong to the Permo-Triassic, perhaps to the very bottom of the Triassic. In all these places of occurrence the bone-bearing horizon is the loose, coarse conglomerate-type sandstone crowded with inclusions of red marl-like clay. The attitude of the beds of the localities is likewise uniform; the sandstone occurs everywhere within the series of variegated marls and sandstones, horizontally and uninterruptedly, coming out on the breaks of river terraces. At a discernable distance the layer lenses abruptly, being replaced by a gray sand. The roof of the heterogeneous marls is well shown in the extreme south of the locality of B. Sludka village on the Vetluga River, in one part of the excavation where there are recorded the following cuts:

I. "Mys" near a ravine.

1. An alluvial layer of yellow-gray sand lies upon the washed-out surface of the stratum of red clay.....78 cm.
2. Blue-grey marl-like sandstone.....15 cm.
3. Dark-red marly clay.....50 cm.
4. Bluish-gray sandstone.....5 cm.
5. Dark-red marl-like clay.....40 cm.
6. Bluish-gray, soft\* marl-like sandstone.....40 cm.
7. Red marl.....5 cm.

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\* Literally, "weak" [Tr].

8. Stratum of gray, dense sand with streaks of hard sandstone.....8 cm.
9. Red marl clay.....8 to 18 cm.
10. Bluish-grey sandy marl.....5 cm.
11. Gray sand streaked with dense flags of sandstone.....20 to 30 cm.
12. Bone-bearing conglomerate sandstone.....5 to 18 cm.
13. Gray sand with occasional dense concretions of sandstone.....

II. The second excavation near the western end of the stratum, 300 m up the river.

1. An alluvial layer lies upon the covering of varicolored marls.....35 cm.
2. Red-brown, washed-out marly clay.....25 cm.
3. Streak of sandstone.....4 cm.
4. Dense gray sand with seams of red clay in the lower part.....148 cm.
5. Bone-bearing sandstone.....5 to 8 cm.
6. Gray sand.....

However, I must point out that the stated thicknesses of layers are by no means exact, because the layers occur quite without order, resulting in great variations of thickness, and indicating a distinct characteristic of the continental formation.

In the other locality on the Vetluga at Pritykino village, the stratum is considerably washed out and poorer in vertebrates, however the underlying strata are exposed here. The cuts of our excavations in this place show the following picture:

I. At Zubovsk village, under the church.

1. Alluvial layer about.....150 cm.

2. Passing down into gray, dense deteriorated sand.....170 cm.
3. Fine-grained conglomerate with rare bones.....5 to 8 cm.
4. Bone-bearing sandstone of the usual type.....8 to 18 cm.
5. Gray sand.....30 cm.
6. Dead gray sandstone.....6 cm.
7. Gray sand.....

Downward there crops out:

- (a) Gray-blue clay.....10 cm.
- (b) Red marly clay.....26 cm.
- (c) Gray-blue marly clay.....5 cm.
- (d) Dove-gray marl-like sandstone.....

## II. At Pritykino (higher up the river).

1. Alluvial yellow sand.....250 to 350 cm.  
which passes downward into
2. Gray dense sand.....75 to 100 cm.
3. Variegated, very hard, and in places black sandstone with bones.....3-6 cm.
4. Gray sand.....50 cm.
5. Red marly clay.....10 to 15 cm.
6. Gray-blue marly clay.....5 cm.
7. Gray sand passing to sandstone.....

Thirty meters still higher the layer lenses.

The thickness of the bone-bearing layer here is stranger than that in B. Sludka.

The areas of the stratum in these two localities can be considered as equal to approximately 3 and 1 km<sup>2</sup>.

Certain other relations are evident in the remaining two localities at Vahknyev on the Sharzenga River and Cherny Bor on the Luza River (Kleuch), localities situated considerably farther north (latitudinally 160 and 235 km). Preserving this same character of loose coarse sandstone, the bone-bearing strata in this place have a decidedly greater thickness, frequently more than 3 meters, and divide into several different overlaps that lens in and out within the stratum. This takes place most abruptly in the localities of Vahknyev on the Sharzenga, where the bone-bearing layer at times is divided up into 8 overlying layers and has a clearly marked irregularity. For an example I shall present bone-bearing stratum from excavation #1 on the bank of the Sharzenga (its average thickness was about 3 m).

1. Loose soft layer of sandstone with occasional bones of a skull.....10 cm.
2. Fragile sandstone with frequent bones.....20 cm.
3. Thin seam of dense conglomerate with a great inclusion of marl.....5 cm.
4. Gray dense sand with occasional bones, running down into conglomerate.....50 cm.
5. Seam of dead gray sand with red discolorations.....10 cm.
6. Layer of loose conglomerate-like sandstone.....52 cm.
7. Flaky layer of a now dense, now loose conglomerate.....50 to 75 cm.
8. A very dense seam of dark sandstone.....5 cm.
9. A loose conglomerate sandstone with occasional bones.....50 to 70 cm.

By going farther into the excavation, we shall see that all the above-mentioned layers lens, [while] going into the mass of dead gray dense sand which in turn runs into various bone-bearing layers, etc. This type of confusion of the layers makes a study of the excavations rather difficult. The roof of varicolored marls in this excavation is washed out in places, and as it comes out at Zahkarovo village it yields a cut like the one that I presented above. The general area of the bone-bearing layer in the place can be figured at approximately 15 km<sup>2</sup>.

The locality at Cherny Bor on the Luza is distinguished from all those described above in that the bone-bearing layer in it is clearly divided into two (2) overlying layers: the usual type of bone-bearing sandstone, and a layer of dense gray sand with concretions including bones. The bone-bearing layer and roof of varicolored marl of the usual type, which are presented here, lie very closely and are not at all washed out, due to the continuous carrying away of the washed out material by the numerous springs.

In all the localities described the bones occur quite haphazardly in the bone-bearing layer, now occurring often, now very rarely, along with which are found bones of the most varied sizes, for example 9 and 150 mm femora, 30 and 400 mm jaws, and the like. This circumstance indicates a numerically large fauna concentrated in a comparatively small space along with a large number of individuals of various ages. According to the available remains it is possible to conclude that the fauna of stegocephalians was represented by no more than three genera that were very closely related to labyrinthodonts: *Benthosaurus*—an inactive land form, *Wetlugosaurus*—somewhat more active and apparently a shore type, and a third, though problematical, genus that is represented by very small fragments. Besides the bones of the

labyrinthodonts, there are found light tubular bones of Reptilia, for the most part belonging to a delicate, active, dinosaur-type form. There is curiously a total absence of invertebrates and remains of plants usually coincidental to stegocephalians, and an extreme scarcity of fish remains. Of the latter there is a tooth of *Gnathoriza pusilla* described by N. N. Yakolyev, rare scales of *Acrolepsis*, and the indispensable\* bits of skeleton. The four described localities can be roughly divided into two groups: the southern ones into which fall the localities at B. Sludka village and the localities at Pritykino on Vetluga River, and the northern: Vahknyev village on the Sharzenga River and Cherny Bor (Springs) on the Luza River. The southern group is characterized by a shallow (not over 18 cm) bone-bearing layer composed of fine-grained sandstone with slight and comparatively rare inclusions of marl. However, this layer also presents changes in its petrographic character and in range of thickness, but in general occurs in a more even formation than do the layers of the northern group. The other distinctions of the southern group are the presence of a greater quantity of finely washed formless fragments of bones, the great scarcity of whole bones and, finally, now and then the occurring complexes of skeletal elements in situ (for example, series of vertebrae, a appendicular skeleton, a complete complex of the thoracic girdle, etc.). The complete skulls in the southern group are extremely rare (to date only one is known—more or less complete), and most of the bones from this group bear traces of washing and of atmospheric influences.

The northern group has, on the contrary, a bone-bearing layer of greater thickness (up to 3 m), of a heavier and coarser sandstone with a greater quantity of marl inclusions

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\* Literal translation [Tr].

that divide up into a multitude of over-layers of varying character, which occur quite without order. The washed-out fragments of bones are decidedly more rare than in the southern group, and the skulls are found much more often. Whole bones are not at all washed-out, in an excellent state of preservation, with a bright thick surface and a perfect preserving glass-like film. Such preservation can take place only in the case of subaqueous burial away from sunlight and air, and it is usually found in limestones and clays without admixtures of materials having detrimental chemical reactions on bones.

In proceeding to the origin of both these groups it is necessary to point out the following facts:

(1) On the skulls found there is no noticeable washing or polishing by water and sand, which inevitably would have to take place if the skull lay in running water.

(2) Notwithstanding the fact that the form of the skull of the stegocephalian is mechanically quite unsuitable for transporting it by water, all the injuries on the whole skulls consisted only in the breaking of the ends of the teeth, and in the breaking out of the cultriform process of the parasphenoid. I shall remark that the latter circumstance exists only in the small skulls in which the cultriform process is very thin.

(3) Rather heavy shingles of red marl were found during preparation of the skulls, on the interior of the deepest part of the brain-pan, for example, in the epipterygoid beyond the quadrate ramus of the pterygoid and in the region of the stapes at the fenestra ovalis. Such a phenomenon can be explained by the fact that these skulls were buried in conglomerate a while after the decomposition (subaqueous) of the soft parts.

(4) The fragments of the very large skulls (approximately 75 to 120 cm) are found in two categories; that in a poor state of preservation with bones fallen apart as if along



their own sutures, apparently having lain for a long time under conditions not tending toward preservation, and that in a good state of preservation, typical for most of the bones broken haphazardly.

The general character of the deposits undoubtedly labels them as of continental formation. The shingles of red marl and marl inclusions in the bone-bearing conglomerates indicate, as P. I. Krotov pointed out, its subaqueous formation in shallow basins in desert plains that dried up periodically. The presence, in the conglomerates, of large red discolorations given off by anhydrous\* iron likewise indicates a hot and dry climate.

The deposition of the northern group of localities evidently originated in the following manner: in the shallow-water feeding-grounds of the desert plain there was being developed an abundant fauna of stegocephalians, which was yielding an accumulation of skeletons on the slimy bottom under the water. Heavy rains, tropical in nature, were giving the beginning to the swift streams that carried out the contents of the bottom of the water feeding-ground and quickly buried these contents at random in pit-holes in haphazard overlays. After that there was begun a rapid evaporation of the water in the small closed basin, and there began the process of fossilization on account of the concentration of salts. Depending upon the power of the flow of the streams the material at time was dashed to pieces (No. 4), and at times was transmitted without any breakage.

In the southern group the deposition went on more evenly and more quietly, evidently in a deeper water-feeding-ground by means of the tributaries that brought the

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\* Literally, "dehydrated" [Tr].

washed bones, bones that had traveled no small distance. The very sandstone in this place was formed out of a finer material, but the remains of an autochthonous origin or those brought by connective soft parts (out of nearby places) yielded the above-mentioned whole complexes of skeletal elements in situ. The absence of remains of plants is explained by the fact that the mud vegetation of these water feeding-grounds, not having a heavy dense stalk, could not be preserved in the coarse conglomerate. It is more difficult to explain the extremely small quantity of fish remains, fish that must have served as food for the numerous stegocephalians. However, because of the lack of data it is possible to presume still other fancied conditions for the concealment of the fish. The above-mentioned genera of stegocephalians that populated these regions do not show adaptability to fast movement in water, which bespeaks a not-too-large water feeding-ground. Purely terrestrial forms are also not represented here, probably as a result of the conditions of land-life, unfavorable for Amphibia.

In conclusion it is necessary to say that with the existence of knowledge of accurate excavations and with the continued investigation of these extremely rich localities, we can positively find out the different biostatic subdivisions of the bone-bearing layers, and it is very possible to find whole skeletons in situ. The extreme scientific importance of the material is undoubted as regards the presence of new forms of stegocephalians and Reptilia, yet the excellent state of preservation of the bones is very valuable for studying their morphology.

(5) The Shihkovo-Chirkovskii locality was visited before by several investigators (N. G. Kassin, A. V. Habakov, G. N. Fredricks, and others) who, however, paid most attention to the stratigraphy or the fish fauna, which, together with labyrinthodonts, is

represented in this place by very abundant material. The Permian marl limestone (“whitey”) that crops out here as the 23rd layer (counting from the top) belongs to the *Unio umbonatus* horizon and is literally permeated with mixed bones of stegocephalians and ganoid fishes. The bones lie in whole groups, bones that are deformed and in a not-too-good state of preservation but are sharply contrasted against the white limestone because they are dark-brown in color and bear no traces of washing or polishing.

Out of the numerous fish gathered here by A. V. Habakov, these three genera are defined with certainty: *Platysomus*, *Amblypterus*, and *Acrolepis*. There are still others not yet studied. The stegocephalians for the most part I shall attribute tentatively to the genus *Platyops*, although during a preliminary examination of the material obtained I found remains of another, as-yet-undefined genus. *Platyops* is an agile predatory form that lived in expansive fresh-water basins whence the rivers or streams brought down the mass of remains of stegocephalians and fish into the estuaries or rather into the estuary with the slimy bottom and the concentration of salts. The bones were carried out, for the most part, in whole carcasses together with the soft parts, and once in the estuary the latter underwent a rapid process of decay that is attested to by the odor of hydrogen sulfide in a fresh break of the bone-bearing limestone. Such burial reminds us of the contemporary burial in Smithers Lake described by Weigelt,<sup>(1)</sup> (1) where are brought together alligators and ganoids (armored pickerels).

I shall take the liberty of saying that this exclusive locality, which to us seems so rare for Permian faunas of stegocephalians, is being mercilessly reduced because the limestone containing the bones is being broken up and burned into lime in kilns.

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<sup>(1)</sup> J. Weigelt, *Rezente Wirbeltierleiche und hare paleobiologische Beudeutung*. Leipzig, 1927.

Inescapable is the adoption of urgent measures for guarding this site by one measure or another, especially because with such a wealth of material we can effect a trade abroad.