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# *MESOPHIS NOPCSAI* n. g., n. sp.

A NEW SNAKELIKE REPTILE FROM THE LOWER CRETACEOUS (NEOCOMIAN) OF BILEK-SELISTA (EAST HERCEGOVINA)

BY

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WITH 3 PLATES AND 5 TEXT-FIGURES

*Mesophis nopcsai* n. g., n. sp., ein neues, schlangenähnliches Reptil aus der unteren Kreide (Neocom) von Bilek-Selista (Ost-Hercegovina)

**SARAJEVO.**

1925

## Introduction.

Through the extraordinary kindness of Herr Engineer Jovan Stojic, the palaeontological collections of the Bosnia-Hercegovina State Museum have been enriched by a highly interesting and rare find. It is a very beautifully preserved skeleton of a snake-like reptile, which is partly imbedded, partly present as an impression on a piece of *Plattenkalk* . This important find was made in a quarry in Selista, a suburb to the east of Bilek. The strata where the skeleton was found, according to the determination of Section Chief Dr. F. Katzer, who died not long ago, to the lower Cretaceous (Neocomian).

After this important find was entrusted to me to be worked on, I immediately started my work.

During my work I have discovered that the counterpart is in the possession of Herr Industrialist Vladimir Mercep in Sarajevo. At my request the gentleman named turned the counterpart over to me to work on, whereby our knowledge of this highly interesting reptile has been substantially furthered.

During the investigation, this snakelike reptile has turned out to be closely related to *Pachyophis woodwardi* described by Baron Nopcsa in the year 1923, though differing from it considerably as a new genus and species. I take with joy the opportunity to name the highly important find in honour of Herr Dr. Franz Baron Nopcsa, Director of the Royal Hungarian Geological Institution in Budapest, as *Mesophis nopcsai* n. g., n. sp., in thankful remembrance of his valuable advice and constant support during my work.

I am also obliged to give the highest thanks to Herr Engineer Jovan Stovic and Industrialist Vladimir Mercep of Sarajevo, as they let me have the valuable find to work on.

I am likewise obliged to Sir Arthur Smith Woodward of Hill-Place, Sussex (England) and Dr. F. A. Bather, curator of the Geology Department of the British Museum in London, for their kind and important advice.

## General observations.

After casting the first glance over the well-preserved skaletal parts (Pl. I and II), one is immediately aware that one is dealing with an animal which stands very close to *Pachyophis woodwardi* recently described by Nopcsa, with the difference that the pachyostosis which is developed to a high degree in this, shows only to a fairly subordinate extent in the other.

The animal - without the posterior part of the body - lies on the ventral [sic, =lower] slab on its back, whereby some very important morphological characters of the vertebral column and the individual vertebrae are very well exposed. On this slab I have also prepared out remains of the skull (Pl. 1c). On the dorsal slab the animal shows its dorsal side; here the ribs are much better preserved.

If one tries to reconstruct the general outline of the animal's body, one sees that we have before us a proportionally very short, quite stocky snake-like animal, compressed on

both sides and with a very small head (Pl. III). The first impression that the fossil makes on one is that of a viperid, with its short, mobile neck, stocky body and short tail.

## **Description of the skeleton** (Pl. I and II)**.**

The preserved skeleton including the skull has a length of exactly 294.3 mm. The greatest width of the body, measured near the middle of the fossil, is 29.5 mm. The skeleton begins with the skull near the middle of the upper third of the slab of stone, immediately followed by a neck portion (diameter ca. 11 mm). After the 11 mm neck diameter the body diameter quite quickly attains the considerable diameter of 29.5 mm, after which it narrows at the end of the dorsal slab (Pl. II) to a diameter of 19.5 mm, from which one can quite rightly conclude that the tail was not very much further away. This is also shown by the vertebrae becoming noticeably smaller towards the edge of the slab, and the ribs shorter. If one extimates the missing posterior part of the body at ca. 13 cm, which seems very probable from the tapering of the end-portion of the fossil, one obtains an animal of about 42 to 45 cm body length. This total length, with the visible stockiness of the animal, corresponds to a snake which had somewhat the appearance of our southern Sandvipers (*Vipera ammodytes meridionalis* Blgr.) or *Causua rhombeatus* Lcht from Africa (south of the Sahara: barely half a metre long), or finally that of *Bitis peringueyi* Blgr from south-west Africa (30 cm).

**Fig. 1**. *Mesophis nopcsai* n. g., n. sp. Lower Cretaceous (Neocomian) of Bilek-Selista (East Hercegovina). Remains of the skull roof from the cerebral side. (Ventral slab.) x 3. im = premaxilla; na = external naris; m = maxilla; f = frontal; o = orbits; tf = *Fossa temporalis* ; p = parietal; q = quadrate; a = atlas.

**Fig. 2**. *Mesophis nopcsai* n. g., n. sp. Lower Cretaceous (Neocomian) of Bilek-Selista (East Hercegovina). a = two cervical ribs (11th, 12th) from the right side. x 3.; b = the neural arch parts of the 32nd-34th trunk vertebrae from the medullary side, with the ribs of the left side belonging to them (Ventral slab) x 3.

**1. Description of the Skull** (Fig. 1). The skull, to judge from the very incomplete remains, may have been very small, with a half-elliptical outline; its length may have been 8.8 mm, the width on the other hand 8.1 mm, so that it was almost as wide as long. What I was able to prepare out from the skull could represent the skull roof, specifically seen from the ventral side. The continuous plate of bone in the midline is on the whole formed by both frontals and the parietal together (Fig. 1, f, p); towards the tip of the skull one sees remains of the premaxilla (im); the first third of the skull to the right and left was bordered by the maxillae (m); on the left side of the skull one can distinguish three openings: anteriorly the external naris (na), around the middle the orbit (o) and finally, between the quadrate (q) and the parietal (p), the temporal fossa (tf). On the right side of the fossil one sees only indistinct traces of the orbit and temporal fossa. Because of the meagre remains, one can have no idea about the posterior outline of the skull. The vertebra marked with the letter a could well have been the atlas.

**Fig. 3**. *Mesophis nopcsai* n. g., n. sp. Lower Cretaceous (Neocomian) of Bilek-Selista (East Hercegovina). The 60th, 63rd, 64th and 65th trunk vertebrae of the ventral slab with their ribs. Ventral view. (The dotted lines show the continuation of the ribs, which are distinctly impressed in the matrix.) x 3.

**Fig. 4**. Reconstruction of the 64th trunk vertebra of *Mesophis nopcsai* n. g., n. sp.with the gigantic, horiontally oval condyle of the centrum. Posterior view. x 3.

**2. Description of the Vertebrae**. The vertebrae - 84 in number on the slabs - are not particularly large in proportion to the long ribs. The cervical vertebrae are ca. 2.6 mm long and 4.3 mm wide; the anterior trunk vertebrae are 3.2 mm long and 5.1 mm wide; the true trunk vertebrae are 3.7 mm long and 6 mm wide. The vertebrae (Figs 2-3) are broader than long throughout; the cervical vertebrae of a more slender construction, the trunk vertebrae **moderately pachyostotic** (see hypothetical reconstruction in Fig. 4) with a procoelous centrum. Most conspicuous on the vertebral centra are the **gigantic** cotyles and condyles, **which correspond to almost the whole width of the centra**.

On the two fairly well preserved centra of the 60th and 64th vertebrae (Fig. 3), one sees that their ventral side is generally flat and shield-shaped with a shallow median depression, two subcentral foramina, and a tiny roundish bump in the middle of the caudal edge.

The distinct remains of the arch-parts of three anterior trunk vertebrae (Fig. 2, 32-34) make it very probable that a primitive zygosphene, zygantrum and a more or less well developed neurapophysis were already formed. Otherwise one finds on the slabs only indistinct remains of the pre- and postzygapophyses and pleurapophyses. The latter are apparently attached near the middle of the lateral edge of the centrum.

**3. Description of the Ribs**. As regards the number of pairs of ribs, one can distinctly count 81 of them. The ribs are massive, single-headed, curved in a weak angle arount their proximal quarter, and directed strongly backwards (apparent on the slab, but in life most probably downwards).

The cervical ribs (Fig. 2a) are very thin, scarcely 0.4 mm wide in the proximal part and approximately 7.5 - 13.5 mm long; in the first third of the body they grow to a proximal thickness of 1 mm and a length of 16.7 mm (Fig. 2b). The true, so-called trunk ribs are at the proximal end below the [rib-] head 1.5 - 1.7 mm thick and approximately 23.2 - 25.5 mm long (Fig. 3). In these ribs one can also perceive a weak collum in the form of a shallow constriction. All the ribs, but especially the trunk ribs, are proportionally very long, the latter moderately pachyostotic towards their proximal end, very thin towards the distal end with the tip transversely cut off. The ribs of the middle of the trunk are somewhat more than three times as long as those of the neck.

## Systematic Position of the Genus *Mesophis*

**Diagnosis of the genus**. The procoelous vertebrae are not especially large and always wider than long; the centrum with a powerful horizontally oval cotyle and condyle (Fig. 3); the pleurapophyses are located on each side apparently in the middle of the lateral edge of the vertebral centra; the trunk ribs are moderately pachyostotic, very long, curved in a weak angle in their proximal quarter, otherwise only very slightly curved, almost straight; very thin at their distal ends.

This genus belongs in the subphylum Tetrapoda; class Reptilia; subclass Holosauria; order Lyognathi Jaekel (1911) (Squamata); suborder Cholophidia Nopcsa (1923); family Pachyophiidae Nopcsa (1923).

*Mesophis nopcsai* is very closely related to *Pachyophis woodwardi* described by Baron Nopcsa in the year 1923 (op. cit.), but differs from it considerably in several important characters. These characters, compiled as a table, are the following:

| | ***Pachyopis woodwardi*** | ***Mesophis nopcsai*** |
|---|---|---|
| 1. | Length according to Baron Nopcsa's estimate 40 (?) cm. | Length according to my reconstruction 42-45 cm. |
| 2. | Length of lower jaw or skull: 36 mm. | Length of the skull: 8.8 mm (?). |
| 3. | Skull slender, pointed. | Skull rather bulbous, with rounded snout. |
| 4. | Body cross section round, in any case not laterally compressed. | Body cross section laterally compressed throughout. |
| 5. | Length and width of a trunk vertebra (60th): 5.4 x 7.5 mm. | Length and width of a trunk vertebra in the vicinity of the 60th: 3.7 x 6 mm. |
| 6. | Approximate length of longest rib: ca. 40 mm. | Approximate length of longest rib: 23.2-25.5 mm. |
| 7. | Greatest diameter of pachyostotic trunk ribs: 3.5 mm. | Greatest diameter of pachyostotoc trunk ribs: 1.5-1.7 mm. |

## Phylogenetic and palaeobiological observations.

Despite almost the whole skeleton of the animal lying before us in two beautiful impressions, on account of the very incomplete skull and completely absent tail one is not able to classify it absolutely exactly in the Natural System. The only available signposts that we possess are the two fairly well preserved centra of the 60th and 64th trunk vertebrae. These centra are completely unlike the same parts of the vertebrae of snakes living today. The only comparative [comparable?] material that I could obtain from our region was our 'Blavor' (*Ophisaurus apus* Pall.). If we consider the corresponding trunk vertebrae of this animal (Fig. 5), we see that its flat, large and wide vertebral centra with their large cotyles and

condyles show much more similarity with those of *Mesophis* than all other snake vertebrae. **Accordingly our animal, as far as vertebral structure is concerned, would more likely be a limbless lizard than a snake**.

**Fig. 5**. The 36th, 37th and 38th trunk vertebrae of *Ophisaurus apus* Pall. with the ribs belonging to them. Ventral view x 2. Sutorina (South Hercegovina), 16.V.1921.

That *Mesophis* has retained these lizard characters in its vertebral structure is only the natural course of things, as according to my view the facility of adaptation of animal organisma decreases centripetally, so that the structure of the vertebral column is the last to be influenced by external forces[*]. But if these, so to speak, centrally located organs, only slightly subject to outside influences, are definitively transformed in a [certain] direction, they obstinately retain their morphological characters. It suffices as an example to point to the vertebrae of the recent snakes, which despite the great diversity of forms actually vary very little. Those parts of the body vary most briskly which are more closely associated with locomotion and obtaining food, e.g. the extremities and the snout-part of the skull. In the case of *Mesophis*, the ribs are just those structures which are associated with locomotion and consequently can serve as the basis for the further discussion. If one looks at the ribs of *Mesophis* only fleetingly, one spontaneously obtains the impression that *Mesophis* must nevertheless have been a snake. The curves of the ribs speak decidely for the body of *Mesophis* being laterally compressed almost throughout. Only the needle-like cervical ribs seem to speak in favor of a round neck. This round neck was from all appearances very mobile, which one can also well perceive from the small, beautiful curves of the neck on the stone slabs.

The trunk ribs, slightly curved in the proximal quarter and otherwise nearly straight, allow us to assume that *Mesophis* did not move on a solid substrate, like the land snakes, but was a constant inhabitant of the water (see reconstruction in Pl. III).

If one compares the trunk ribs of *Mesophis* with those of *Ophisaurus* (Fig. 5), one sees that both ribs are constructed similarly to a certain extent, i.e. curved at an angle in the proximal quarter, though with the cardinal difference that their distal ends are totally different in form.

In *Ophisaurus* and in most living snakes especially - apart from the fact that the whole rib is uniformly curved - the distal ends of the ribs are suddenly and quite strongly curved inward, which is never the case in *Mesophis*. In this, all the ribs are fairly thick towards the proximal end and slightly curved in the proximal quarter, so that one can distinctly differentiate a dorsal and a lateral part of the individual ribs; for the rest of their length they are gradually thinner, very slightly curved, almost straight and at the distal end they end as if

[*] On this matter, see my work 'Prinosi herpetologiji zapadnoga dijela Balkanskog Poluostrva (Additions to the Herpetology of the Western Balkan Peninsula). Glasnik zem. muzeja u Bosni i Hercegovini XXXI. Sarajevo 1919: 37

they had been chopped off straight across. In the limbless lizards and the land snakes the body weight alone causes the ribs to be formed with a curve throughout their length. In a purely aquatic animal, as *Mesophis* had to have been, the body weight would not have any effect due to gravity: the ribs grow free to a long, elongated and sharp form, and in this growth they are not only not hindered by the undulating swimming motion of the body, but actively assisted. The laterally compressed body, then, comes about as a result of swimming. As a consequence of all these considerations one can assume that *Mesophis* was a pelagic-living animal, somewhat like today's seasnakes. Its food would have consisted of small crustaceans, worms, coelenterate larvae and also very young fish, which it fished out of the water with lighning-fast forward strikes of the head.

The moderately developed pachyostosis on the trunk vertebrae and ribs may have served as protection against the impact of waves or against water pressure during the probably frequent dives. Diving to a fair depth may have had a double significance: **Flight from pursuers, or extension of hunting grounds into deeper, though certainly still well-lit layers of the water**.

*Mesophis nopcsai* and its relatives may thus have played the same role in the lower Cretaceous seas as today's seasnakes in the tropical seas.

There now remains only to say something on the following two questions: 1. From where do *Mesophis* and the related form *Pachyophis woodwardi* descend?, and 2. Can all these collective types have served as the initial forms for the later land snakes, or not?

To 1. In connection to the view of Baron Nopcsa (1923: 144) I would like to trace these **snakelike** reptiles back to a dolichosaur. These animals with their elongate body, small head, limbs disappearing, and their pachyostotic ribs, tempt one directly to this assumption. The process is analogous to that where a four-footed reptile loses its limbs in the course of evolution and transforms into an elongate, limbless, snake-like form. Only the surroundings which cause this transformation are different. In the case of land lizards, constant undulation in grass, bushes, between stones etc. give the first impulse for the disappearance of limbs; in the sea, on the other hand, constant swimming and diving bears responsibility for the total deconstruction [*Rückbildung*] of the limbs, already reduced [*rückgebildet*] to fins.

To 2. Such specialised forms as *Mesophis*, with their laterally compressed bodies, were already so far adapted to contant aquatic life that - just as in some recent seasnakes - on being accidentally washed up they would necessarily die. Under 'washing up' I understand the geological process of many organisms being left behind by a sinking of the sea level.

The origin of land snakes is still wrapped in darkness. The first boids, such as e.g. *Palaeopython* Rochebrune (Zittel 1887-90, Handbuch der Palaeontologie (I), III: 628) appeared already with a gigantic body in the Eocene. This giant body alone shows that even these proto-boids must look back on a monstrously long phylogeny, as one can see clearly from the example of *Mesophis* and *Pachyophis* that the first limbless, snake-like reptiles were quite small organisms. Cope (1898: 706) derives all snakes living today from the boids and it

is also correct that the latter stand the closest in some respects to the tetrapodal original ancestors of snakes. The boids themselves look back on a long series of ancestors, among which quite certeinly a mob of limbless lizards are to be called in, which filled the gaps between the tetrapodal original ancestor (ancestors?) of all snakes and between the true snakes. So far, palaeontology has unfortunately not yet provided us with such connecting members.

In conclusion I would like to say a few more words on the contradiction which exists between me and Baron Nopcsa over the way of life of *Pachyophis* and *Mesophis*, and over the cause of pachyostosis. Baron Nopcsa assumes for his *Pachyophis* (1923: 137) that it led a benthic life in a shallow near-coastal sea, and the thickening of the bones in the trunk vertebrae and -ribs appeared as a consequence of this way of life*. From Baron Nopcsa's witty manner of explanation (1923, Ch. 5 on Arrostia, p. 112-117) one can easily understand how and why the benthic way of life would lead to pachyostosis, but what sort of depth should we assume for such a small animal as *Pachyophis* or *Mesophis*, that the term 'benthos' covers? If one estimates the 'shallow sea' assumed by Baron Nopcsa to be only about 10 m, there arise heavy reservations against the way *Pachyophis* could come up from these depths to breathe on the surface as often as is necessary in a reptile. These reservations multiply even further if one assumes the depth to be greater. Because for the sake of Nopcsa's hypothesis, that the pachyostosis of *Pachyophis* was elicited by a benthic way of life, or in other words that a fairly high water pressure is necessary for pachyostosis to arise, one must rather accept a **greater**, than a **lesser** depth.

But do such depths offer favorable living conditions for a poikilothermic vertebrate such as a reptile? One can only answer this question in the negative, and on several grounds. Firstly, the water is already so cool at a slight depth such as 15-20 m that it is no longer acceptable for a reptile; further, to come to the surface to breathe from such depths is also something that one can not easily imagine, the less so because Baron Nopcsa characterises *Pachyophis* as an animal with a stocky body that **could probably only move slowly** (1923: 137); finally, likewise barely thinkable, a rapid movement of the neck at these depths, on account of the pressure and resistance of the water.

But if we assume a really quite shallow sea of 3 - 4 m depth, the basic conditions for the appearance of pachyostosis immediately disappear, for such slight masses of water are not sufficient to exert a pressure which leads in the end to thickening of the bone. If such depths were sufficient, then every species of *Triton* - which stay almost constantly on the bottom of a 3-4 m deep water reservoir and only come to the surface to breathe from time to time - would show at least a trace of pachyostosis on the trunk vertebrae and -ribs.

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* Baron Nopcsa actually demonstrates nothing about the benthic way of life or about the immediate cause of pachyostosis; but after he has explained the whole process by 'artificial' respiratory stress causing hyperaemia and hyperplasy of the marrow, which causes degeneration of the marrow, one can assume that he regarded this physiological process as elicited by the benthic way of life. Artificial respiratory stress can principally occur in aquatic animals in voluntary and involuntary diving.

I would like to compare the cholophidians - as far as way of life is concerned - rather with such long-necked forms as *Nothosaurus* and the plesiosaurs, which hunt their prey partly swimming on the surface, partly diving in the depths.

Sarajevo, 7th November 1925.

## Explanation of the plates.

Plate I. *Mesophis nopcsai* n. g., n. sp. Lower Cretaceous (Neocomian) of Bilek-Selista (East Hercegovina). Ventral slab, natural size. The slab is the property of the Palaeontological Collection of the State Museum in Sarajevo. This plate was made at the time when the skull had not yet been prepared out of the matrix. The small drawing with the white outline shows the place where the remains of the skull (c) lie; 60. means the sixtieth, 64. the sixty-fourth trunk vertebra.

Plate II. *Mesophis nopcsai* n. g., n. sp. Lower Cretaceous (Neocomian) of Bilek-Selista (East Hercegovina). Dorsal slab, natural size. This slab is the property of Herr Vladimir Mercep in Sarajevo.

Plate III. *Mesophis nopcsai* By. Natural size. Reconstruction by Dr. St. J. Bolkay; drawn by E. Germ (this reconstruction was drawn before the discovery of the skull).