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A detailed description of *Caspiodontornis kobystanicus* from the Oligocene of the Caspian seashore

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Abstract. The paper presents a detailed description of a skull and mandible of *Caspiodontornis kobystanicus,* which is a middle-sized member of the bony-toothed birds, differing distinctly from those so far described. It had an alongated pelecaniform bill, flattened dorso-ventrally.The upper bony-teeth were comparatively small, those in the lower jaw being larger. Holorhinal nares narrow, pterygoid comparatively short, wide, pelecaniform.

Key words: Odontopterygiformes, *Caspiodontornis kobystanicus,* Oligocene, Apsheron Peninsula, Perekishkyul locality.

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I. INTRODUCTION

The first bony-toothed bird, *Odontopteryx toliapica* OWEN, 1873, was reported from the Early Eocene of England. Next a number of other species were described (SPULSKI 1910, HOWARD 1957, HOPSON 1964, etc.). BRODKORB (1963), just as OLSON (1985) later, treated the bony-toothed birds as a suborder in the order Pelecaniformes. In addition to the descriptions of some new species the monograph by HARRISON & WALKER (1976) presents a revision of this group of birds raised to the rank of a separate order, Odontopterygiformes, which, besides, had already been proposed by HOWARD (1957) before. HARRISON & WALKER (1976) have devided the order Odontopterygiformes into four families: Odontopterygidae, Pseudodontopterygidae, Dasornithidae and Pelargonithidae.

The present paper provides a detailed description of a skull and mandible of *Caspiodontornis kobystanicus* ASLANOVA et BURCHAK-ABRAMOVICH, 1982. However, it does not give the final word as to the systematic position of this bird, although originally we (ASLANOVA et BURCHAK-ABRAMOVICH 1982) had numbered it among the Pseudodontornithidae. We leave this problem open to those who will be able to compare the skull of *Caspiodontornis* directly with the remains of other bony-toothed birds to.

In 1977 the finding of *Caspiodontornis* was the first record of bony-toothed birds in Asia. At present some fragmentary mandibular remains of *Odontopteryx tschulensis* and *Odontopteryx* sp. are known from Kazakhstan and Uzbekistan (AVERIANOV et al. 1991).

II. LOCALITY AND ITS GEOLOGY

The Perekishkyul locality, where the skull under description was found in 1977, is situated in the Apsheron Peninsula (the west coast of the Caspian Sea). The remains of the fossil swan *Guguschia nailiae* ASLANOVA et BURCHAK-ABRAMOVICH, 1968, come from the same locality.

As far as stratigraphy is concerned, the locality is a syncline built of Oligocene marls belonging to the Maykopian complex and underlain by Eocene sediments. The greater part of this profile (204 m) consists of Oligocene layers, the Chattian in the upper part and the Rupelian, locally known as the Stampian (HAQ and EISINGA 1989), below. Lithologically, the upper part of the profile is composed of Oligocene intercalations of grey and dark grey (almost black) clays with bands of compact sideritic sandstones. Underneath occur brown and chocolate, plastered with an admixure of jarosite clays with dolomitized marly concretions. Further there are light, yellowish and yellowish-green clays with interbeddings of sandy marl. All the layers contain a characteristic fauna. The richest fauna is encountered in the deposits of the Younger, Middle and the upper part of Older Oligocene.

The skull under study was lying on the eroded surface of the Maykopian rocks and probably constituted a part of a whole bird skeleton, but the remaining parts have not been found.

A preliminary list of the fossil fauna of the Perekishkyul locality collected up to 1988 (compiled by S. M. ASLANOVA):

Mammalia: *Microzeuglodon caucasicum, Atropatenocetus posteocenicus , Kellogia barbarus, Insopsis caucasica, Oligodelphis bogatchovi, Acrodelphis oligocenica, Ferecetotherium kellogii, Cetotherium* sp., *Phoca* sp., *Halitherium* sp.

Aves: *Guguschia nailiae* and *Caspiodontornis kobystanicus,*

Reptilia: *Glarichelys gwimmeri,*

Pisces: *Sardinella engrauliformes* and 17 other species,

Crustacea: *Portunus atropatanus, Pr.* cf. *landetodactylus* and *Inachus* sp.

Malacofauna: *Spirialis* sp., *Pectunculus* sp., *Lucina* sp., *Ostrea* sp.

Microfauna: *Globigerina* ex. gr. *bulloides, Glomospira charoides.*

The insect remains are being analysed. A further study of sea mammals is under way. (ASLANOVA, MCHETLIDZE).

III. DESCRIPTION

Order: Odontopterygiformes HOWARD, 1957

Family: indefinite

Genus: *Caspiodontornis* ASLANOVA et BURCHAK-ABRAMOVICH, 1982

Caspiodontornis kabystanicus ASLANOVA et BURCHAK-ABRAMOVICH, 1982

H o l o t y p e: skull and mandible of one individual.

L o c u s t y p i c u s: region of the village of Perekishkyul, Apsheron Peninsula, eastern Azerbeijan.

G e o l o g i c a l a g e: Middle Oligocene, Maykopian deposits

P l a c e o f s t o r a g e: Baku, G. Zadrawi Museum of Natural History; No: A-2/11-78.

D i a g n o s i s o f g e n u s. Medium-sized bony-toothed bird. Relatively small bony teeth in upper jaw, larger ones in mandible but, in general, smaller relative to skull size than in remaining bony-toothed bird genera. In principle, the "teeth" are placed vertically, but there are also some single ones which slant somewhat anteriorly, more rarely posteriorly. One of the large upper frontal "teeth" (presumably the second) slants forwards at an angle of about 45°. The "teeth" occur all over the length of the upper and lower jaws. Small and middle-sized "teeth" are usually present between the large ones. The general measurements, including the height of the "teeth", gradually diminish towards the back. The "teeth" are solid. Pelican-type rostrum, considerably dorsoventrally flattened, elongated. Its ventral surface slightly bent inwards, somewhat resembling a trough. The relatively narrow holorhinal nares lie in the grooves extending down along the rostral sides. The pe-

lecaniform pterygoid is broad, relatively short. Nasal substantially widening in its posterior half. Braincase comparatively short.

The diagnosis of species corresponds with this of the genus.

C o m p a r i s o n s. The structure of the skull and mandible evidently differs the genus *Caspiodontornis* from the other genera of the Odontopterygiformes and recent Pelecaniformes. The rostrum of *Caspiodontornis* is considerably dorso-ventrally flattened, in which it resembles the pelican rostrum. Its ventral surface is shallowly concave, channel-like, which differs it significantly from the remaining bony-toothed and recent totipalmate birds, in which there is no or only a slight concavity. The nasals are raised above the surface of the rostrum and head to a height of 2-4 mm. In the remaining bony-toothed and totipalmate birds such an elevation is not observed and the boundaries with the adjoining bones are not well defined. The triangular sunken plate between the medial edges of the nasals, distinct in *Caspiodontornis,* is either absent from or very weakly marked as a small depression in the other bony-toothed and totipalmate birds. The pterygoid of *Caspiodontornis* resembles that of *Pelecanus onocrotalus* and differs from the pterygoid of *Odontopteryx.* The "teeth" of *Caspiodontornis* are, as a rule, placed vertically, although some of them slant somewhat anteriorly and single ones posteriorly. One of the upper frontal "teeth" has an anterior slant at an angle of 45°. In *Odontopteryx* the "teeth" stand vertically, in *Pseudodontornis* are slightly inclined forward.

Description of specimen

The cranium and mandible were lying in the rock together, but have been separated during extraction. The measurements of the specimen are given in Table I. Both the skull and mandible are heavily deformed. Because of its deformation and damage the skull cannot be thoroughly reconstructed. Moreover, all the parts of the skull are not preserved. The strong flattening of the rostrum and braincase is striking. The flattening of the rostrum gives the bill of *Caspiodontornis* the shape of pelecaniform species, which is to be acknowledged as characteristic, for if the deformation could have had an influence on the degree of the rostral flattening, it would not have been remarkable. The frontal, prefrontal, nasal, lacrimal, intermaxillary and maxillary bones can be distinguished on the dorsal surface of the skull. Not all the sutures between particular bones are visible – in many cases they can only be conjectured. The braincase is compressed. The orbital regions and fragments neighbouring on them are crushed. The anterior tip of the rostrum is obliquely broken away. Both mandibular branches occur together but are shifted in relation to each other.The right branch projects by 40 mm in front of the left.The mandibular symphysis is preserved on the right branch in the form of a rim, 21 mm high and 10 mm thick. Its upper part is obliquely anteriorly inclined. The lower part of the rim constitutes an extension of the lower edge of the right branch.

In the work by ASLANOVA & BURCHAK-ABRAMOVICH (1982), comprising the description of the genus *Caspiodontornis,* the captions for Figs 1 and 2 give mistakenly that the photograph (в) shows the left mandibular branch of another specimen. As a matter of fact, phot. (б) presents the left branch with a posterior part of the right branch stuck to it and phot. (в) – the anterior part of the right branch of the same mandible.

The braincase is heavily damaged, dorsoventrally flattened so that the occipital part has changed into a transverse roller, about 11 mm thick. Occipital foramen destroyed, occipital condyle resembling a ball in shape, with a somewhat greater transverse diameter (Table I: measurements 23 and 24).

The ventral portion of the braincase is missing. The posterior parts of the palatines are not preserved. The palatines taper zanteriorly and come closer to each other; eventually their medial edges touch each other at an acute angle and further the left bone overlaps the right (result of deformation). Between the medial edges of the palatines there is an oval plate up to 35 mm in length and 8 mm in its greatest breadth. The palatine is transversely convex, longitudinally straight. The anterior edge of the palatines lies 135 mm ahead of the posterior edge of the occipital condyle, approximately in the line of "tooth" No 6. The left pterygoid, with a fragment of the quadrate stuck to it, is preserved

Table I

Measurements (in mm) of the skull and mandibles of *Caspiodontornis kobystanicus*

No	Measurement	Size
1	Greatest length of preserved part of skull (basion – line of first big "tooth")	305
2	Presumable overall length of skull (basion – anterior end of rostrum)	ca 320
3	Dorsal length of skull along sagittal midline (opistocranion – naso-prefrontal fissure)	93
4	Length of rostral part as preserved (posterior prominence of nasals – anterior end at hinge)	215
5	Greatest dorsal width of skull	ca 64
6	Width of skull at posterior edge	ca 64
7	Greatest dorsal width of rostrum, aproximately half-way along	ca 52
8	Anterior width of rostrum at hinge	ca 31
9	Greatest width of one max illary nasal process	28
10	Greatest width of both intermaxillary nasal processes of	45
11	Width of rostrum between medial edges of nares	42
12	Length of naso-prefrontal fissure	ca 48
13	Greatest width of preserved part of one palatine	ca 24
14	Same, of two palatines together	ca 50
15	Greatest length of preserved portion of left palatine	ca 85
16	Width of rostrum at level of intermaxillary suture	ca 45
17	Distance between intermaxillary suture and posterior top of nasals	ca 147
18	Distance between intermaxillary suture and posterior point of skull	ca 234
19	Distance of posterior edge of nares from line of posterior edge of both nasals	ca 10
20	Length of narial sulcus (to suture with intemaxillary)	ca 126
21	Length of pterygoid	ca 33
22	Greatest width of pterygoid	ca 15
23	Height of occipital condyle	10
24	Width of occipital condyle	11
25	Length of right mandibular branch, as preserved	ca 225
26	Length of left mandibular branch, as preserved	ca 224
27	Greatest height of mandibular branch in middle part	23
28	Least height of mandibular branch in anterior part	15
29	Greatest thickness (mediolateral) in middle part of mandibular branch	ca 7
30	Thickness of mandibular branch at its lower edge	3-5

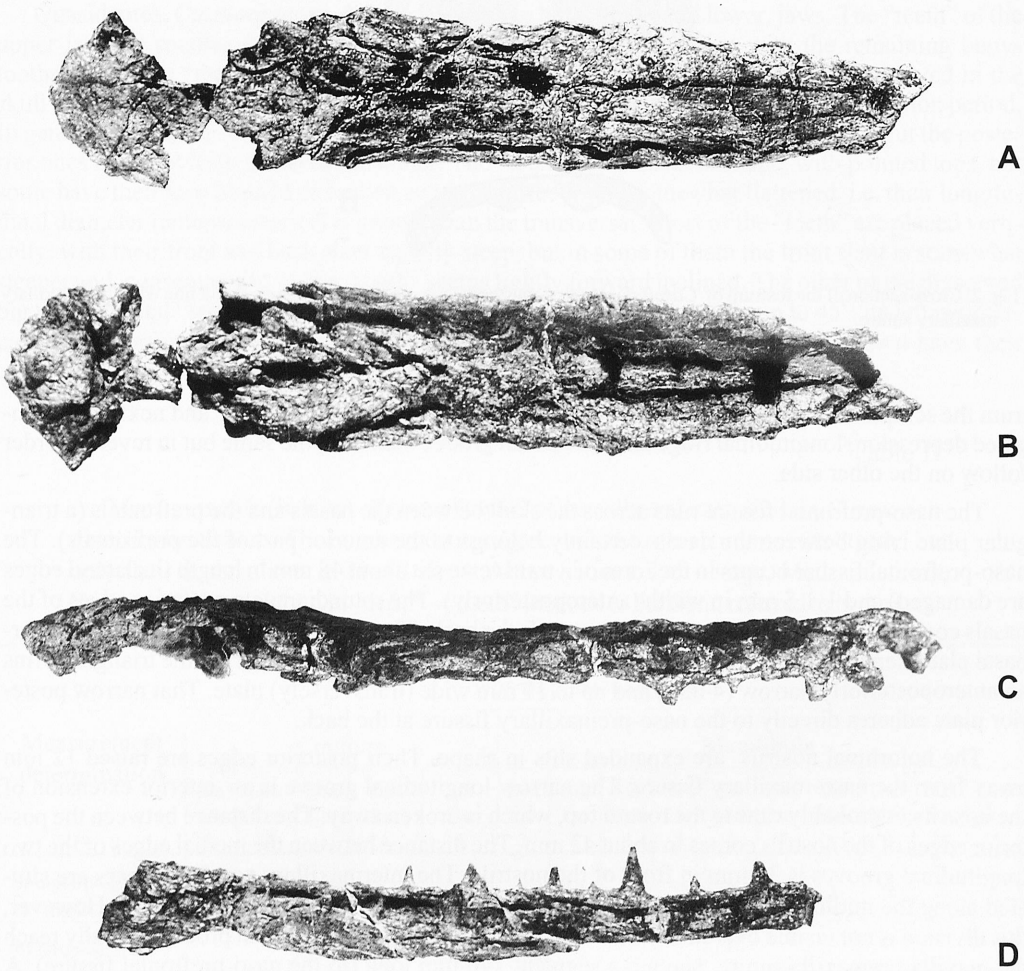

Fig. 1. Photographs of a specimen of *Caspiodontornis kobystanicus*: A – braincase and rostrum (dorsal view), B – braincase and rostrum (ventral view), C – lateral view of the skull and rostrum with bony teeth (right side), D – right mandible (medial view). All pictures a little smaller than 1/2 of natural size.

separately from the skull. The upper surface of the braincase is damaged (the left side more so than the right). Its lateral edges are missing.

The rostrum is partly damaged and deformed, laterally broken off in places. On its ventral surface, along the sagittal mid-line, a groove 7 mm wide and 4-5 mm deep, extends to the front, starting approximately from the line of "tooth" No 4. On both sides this groove is limited by longitudinal ridges, up to 5-6 mm wide and 3-5 mm high (Fig. A). In the anterior part of the rostrum the middle groove is broader and shallower and the lateral ridges become lower (Fig. B). Anteriorly, the groove and ridges end abruptly where the rostrum hinges. Longitudinal depressions extend for the whole length of the rostrum laterally and parallel to the ridges. In this way on the cross-section of the ros-

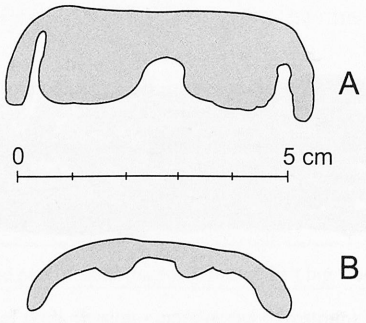

Fig. 2. Cross-section of the rostrum of *Caspiodontornis kobystanicus*: A – posterior to nares, B – in line with intermaxillary-maxillary suture.

trum the sculpture of its ventral surface consists of the lateral edge with "teeth"and next of an elongated depression, longitudinal ridge and the midian groove behind it; the same but in reversed order follow on the other side.

The naso-prefrontal fissure runs across the skull between the nasals and the prefrontals (a triangular plate lying between the nasals certainly belongs to the anterior part of the prefrontals). The naso-prefrontal fissure occurs in the form of a transverse slit about 48 mm in length (its lateral edges are damaged) and 1-1.5 mm in width (anteroposteriorly). The rotundiarcuate posterior edges of the nasals cover the slit over its 2-3 mm zone towards the back. The posterior part of the triangular internasal plate, separated by a transverse slit (crack) from the greater anterior part of the triangle, forms an anteroposteriorly narrow (4 mm) and up to 11 mm wide (transversely) plate. That narrow posterior plate adheres directly to the naso-premaxillary fissure at the back.

The holorhinal nostrils are expanded slits in shape. Their posterior edges are raised 12 mm away from the naso-maxillary fissure. The narrow longitudinal groove is an anterior extension of the nostrils; it probably runs to the rostral top, which is broken away. The distance between the posterior edges of the nostrils comes to about 42 mm. The distance between the medial edges of the two longitudinal grooves is 38 mm in front of the nostrils. The intermaxillary nasal processes are situated along the midline of the rostrum and separated by the median longitudinal groove. However, this division is not visible over its whole extension. Both intermaxillary nasal processes orally reach the maxilla-premaxilla suture, leaving a segment 146 mm long (to the naso-prefrontal fissure). A narrow smooth plate, corresponding to both intermaxillary nasal processes is no longer divided into two, right and left, parts.

Pterygoid. The detached left pterygoid is preserved. It resembles this bone of *Pelecanus onocrotalus* and differs thoroughly from that of *Odontopteryx,* which, in turn, is more similar to the pterygoid in *Cygnus atratus* and *Macronectes giganteus* (HARRISON and WALKER 1976: p. 51, Fig.29). The pterygoids of the remaining bony-toothed birds are not known. The pterygoid in *Caspiodontornis* is thicker than that of the pelican, but they resemble each other in general form and proportions. It is about 33 mm long in *Caspiodontornis* and 26 mm in *P. onocrotalus.* The greatest width is, respectively, about 15 and 12 mm and the smallest width in the posterior part, 11 and 7.5 mm. The lower surface of the bone is a narrow plate, 6 mm in width in the middle – 4.5 mm in the pelican.. In both species the upper edge of the bone is sharpened. In *Caspiodontornis* the lower plate is transversely (mediolaterally) bent in and in the pelican it is flat. In both species the medial surface is weakly curved inwards, in *Caspiodontornis* the lateral surface is almost flat and in the pelican considerably bent in (from the top downwards). The upper-posterior part of the bone in *Caspiodontornis* is damaged; in the pelican an upward set-up occurs here. An analogous set-up was probably present also in *Caspiodontornis* – associated with it is probably the tubercular elevation of the posterolateral portion of the bone, measuring 10 mm (anteroposteriorly) by 7 mm (from top down-

wards). A fragment of the left quadrate with the pterygoidal fossa is "glued" to the posteromedial part of the bone.

Quasidentes. *Caspiodontornis* had bony-teeth in both, upper and lower, jaws. The "teeth" of the upper jaw are smaller than the lower ones (Table II). In comparison with the remaining bony-toothed birds the "teeth" of *Caspiodontornis* are smaller. Not all the "teeth" are preserved in the skull under study. Some of them had already been broken off or damaged in the fossilization period. In general, the "teeth" occurred for nearly whole lengths of the upper and lower jaws, but the posterior ones have not been preserved in either. The "teeth" are conical in shape, with pointed tops, but some have their tops blunted or broken away. The "teeth" are somewhat flattened, i.e. their longitudinal diameter (anteroposterior) is greater than the transversal. Most of the "teeth" are placed vertically, with their front and back slant equally steep, but in some of them the front slant is somewhat steeper and, consequently, such a "tooth" seems lightly forward inclined. The other of the preserved big upper frontal "teeth" (right) has its top inclined anteriorly at an angle up to 45°; its left counterpart is not preserved. None of the remaining genera of the bony-toothed birds known have their "teeth" so strongly inclined to the front.

Table II

Measurements (in mm) of some "teeth" of maxilla and mandible in *Caspiodontornis kobystanicus*. The numbers do not agree with the actual order of the "teeth" but only their designations in Figs 3 ans 4. Abbreviations: Lar – large, Med – medium, Sm – small, Dex – right, Sin – left, * – "tooth" inclined to the front, referred to in the text

Measurement determination	Nos of particular "teeth"														
	Cranium					Mandibula									
	Sin Lar 1	Dex Lar 2*	Dex Lar 3	Dex Lar 4	Sin Lar 4	Dex Lar 2	Sin Lar 3	Sin Med 4	Dex Lar 5	Sin Med 6	Dex Lar 7	Dex Med 8	Dex Med 9	Dex Sm 10	Dex Sm 11
Straight height of "tooth"	9	14	10	8.5	9	7	17	8	12	8	17	6	6	4	3
Anteroposterior diameter of "tooth" at base	9.5	12	10	9	8	7	8	5	10	5	10	5.2	5	3	3
Transverse diameter of "tooth"-base	5	6	6.5	7	6.5	5	7	5	6	4	ca5	ca3	ca3	–	–
Dimensions of top area	4x4	6x5.5	4x4	3.5x3.5	2.5x2.5	0.5	pointed top		blunted top						

Seeing that the anteriormost part of the rostrum is missing, there are no data concerning the first (probably two or three) upper bony-teeth. In this connection the introduced numbers for "teeth" permit their identification (text – Table II – Figs A, and B), but do not agree with their actual order. Left big "tooth" No 1 is the first in the preserved part of the rostrum. It stands vertically, its conical top is blunted and terminates in an oval area 3x4 mm in diameter. "Tooth" No 2 is situated right behind it, almost touching it, (the right one is preserved, of the left only a basal rest is present). "Tooth" No 3 – both are preserved, the right whole, the left with its top broken away; its frontal slant is gentler and the posterior one steeper; as a result the "tooth" seems to be inclined backwards.The interval be-

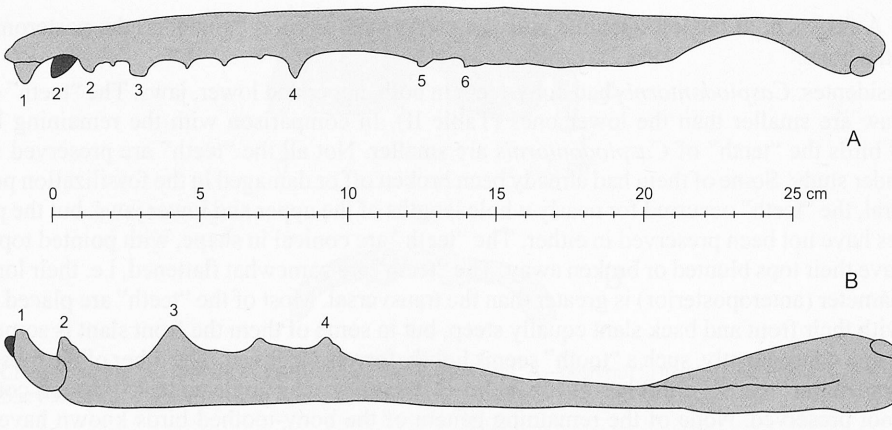

Fig. 3. Lateral view of the skull and the array of bony teeth preserved on the rostrum of *Caspiodontornis kobystanicus*: A – left side, B – right side. The numeration of the "teeth" corresponds with that applied in Table II and in the text.

tween "teeth" No 2 and No 3 is 42 mm. Both "teeth" No 4 are present. The distance between "teeth" No 3 and No 4 comes to 40 mm. Further to the back the "teeth" are not preserved on the right side of the rostrum. On the left side , at a distance of 21 mm from "tooth" No 4 a small blunt "tooth", 2 mm high and 2.5 mm wide at the base, is preserved and followed at a distance of 30 mm from "tooth" No 4 by a low blunt "tooth", 5.5 mm high and 7 mm wide at the base – no "teeth" have been preserved further to the back of the left side. In the spaces between big "teeth" No 2, No 3 and No 4 in the anterior half of the rostrum there are small "teeth". Two of them occur beween "teeth" Nos 2 and 3 : the first counting from the front, 6 mm high and 6 mm wide at the base, with a blunted top, and the second, 3 mm high and 3 mm wide at the base. Four small "teeth" lie in the interval between big "teeth" No 3 and No 4 : the first from the front, a minature one is 0.5 mm high, the second 2 mm high and 3 mm wide anteroposteriorly; the third is a comparatively bigger "tooth", 5 mm high and 7 mm wide anteroposteriorly, and followed by the fourth, 2 mm in both height and width. At a distance of 14 mm behind the left big "tooth" No 4 there is a small tubercular "tooth" No 5 and 11 mm farther a small "toothlet", No 6, 0.5 mm high and 6 mm wide at the base. The bony teeth in the mandible are stronger and better preserved than those in the upper jaw (Figs. A and B). As a rule, they are positioned vertically. They occur over the whole length of both preserved branches of the jaw. "Tooth" No 1 is of medium size; only the base of the right "tooth" is preserved, its anteroposterior diameter being 5 mm. Big "tooth" No 2 – preserved are the right and left "teeth", the distance between "teeth" No 1 and No 2 is 12 mm. Big "tooth" No 3 – the left one whole, the right broken less than half-way up its height. Judging by the base (the posterior slant more gentle), it was inclined forwards. In the 30-mm interval between large "teeth" No 2 and No 3, there are three small "toothlets" of which the anterior and the posterior are very small, 1.5 mm high, and the middle one is somewhat larger, 5 mm high and 3 mm wide at the base. "Tooth" No 4 is moderately high (the top of the right one is broken away). The interval between "teeth" No 3 and No 4 comes to 18 mm . There are 3 "toothlets" on this segment , of which the anterior and posterior ones are very small in the form of poorly projecting tubercles and the middle one, somewhat larger, is 3 mm high and also 3 mm wide anteroposteriorly at the base. Large "tooth" No 5 (the right one whole and the left broken in the middle) is slightly inclined to the front – the blunt top of the right "tooth" ends in a plane, up to 4 mm in dia. The distance between large "teeth" No 4 and No 5 is 14 mm and there are 3 "toothlets" there, the anterior and posterior small "toothlets" in the form of hardly protruding tubercles and the middle one larger, 4 mm high and 3 mm wide anteroposteriorly. "Tooth" No 6 of medium height – the left one with a pointed top is preserved and only a fragment of the right. In the 14-mm space between "teeth" No 5 and No 6 there is a tiny tubercular "toothlet", 2 mm high and 3 mm wide at the base. Large "tooth" No 7 has been preserved in the right jaw; slightly inclined to the front, it has a blunt top. Similarly, large right "tooth" No 8 with a blunted top is lightly inclined to the front. The distance beteen "teeth" No 7 and No 8 amounts to 14 mm and there is a small tubercular "toothlet" there, 2 mm high and 3 mm across at the base. Medium-sized "tooth" No 9 has a blunted top and lightly laterally deflected long axis

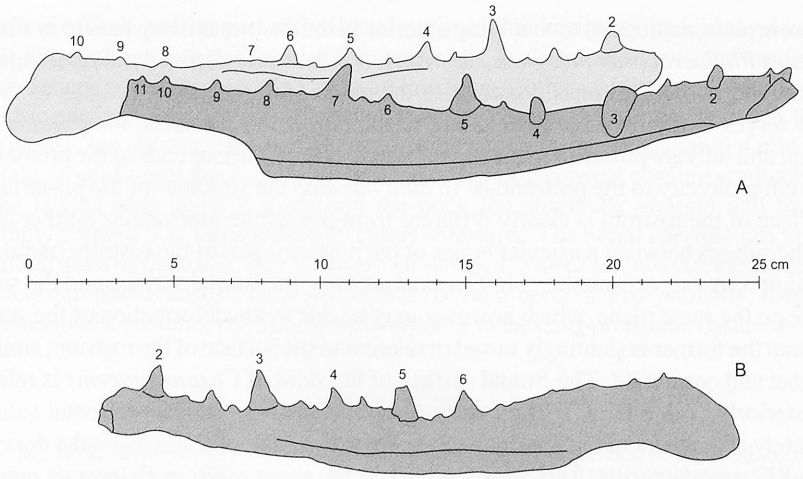

Fig. 4. Mandibles and the arrangement of bony teeth preserved in *Caspiodontornis kobystanicus*: A – right and left branches of the mandible united toghether (external surface of the right branch and the internal of the left), B – external surface of the left mandibular branch.

(perhaps owing to its deformation). It is situated at a distance of 14 mm from "tooth" No 8 and no additional small "toothlets" can be seen over this interval (perhaps not preserved). Small "tooth" No 10 has both slopes uniformly steep and a blunted top. Small "tooth" No 11 is rather indistinct. No further "teeth" are preserved behind "tooth" No 6 on the left branch of the mandible.

IV. COMPARISONS WITH THE ODONTOPTERYGIFORMES AND PELECANIFORMES

The general measurements of the braincase of *Caspiodontornis* are smaller than those in *Pseudodontornis, Osteodontornis* and *Neodontornis,* but larger than in *Odontopteryx, Macrodontopteryx* and *Dasornis.*

In all the genera of the Odontopterygiformes described earlier the height of the rostrum relative to its length is similar and close to that in gannets and cormorants. This is evidenced by the value of index A (Table III), which in *Caspiodontornis* comes nearest that for the pelican. In addition to the flattening of the bill in the modern *Pelecanus onocrotalus* also the transverse profile of the ventral surface of the rostrum is analogous, although it has more complex structural details, which in *Caspiodontornis* may have not been preserved because of the damage to the skull. Furthermore, both nasals of the pelican lie higher above the nares and form small prominences, separated by a narrow plane of the premaxillary nasal process. As in *Caspiodontornis,* in the pelican the smooth plane, which corresponds to both premaxillary nasal processes, extends along the sagittal midline on the upper surface as far as the top of the rostrum. However, in contradistinction to the specimen of *Caspiodontornis*, the pelican lacks the median groove separating the right and left premaxillary nasal processes. Similarly to the caspiodontornis, the transverse suture between the intermaxillary and maxillary bones can be seen on the rostrum from above and less distinctly from below. The rostra of *Caspiodontornis* and pelicans , irrespective of resemblance in the degree of their flattening, differ significantly in general shape (Table III: Index B). In *Pelecanus onocrotalus* the rostrum is considerably longer and relatively narrower. In *Caspiodontornis* it gradually broadens anteroposteriorly, except for a lightly marked narrowing in the middle part, whereas in the pelican it is broadest in the anterior half and tapering considerably in the posterior. In the pelican the rostrum achieves its greatest breadth about one-third of the way backwards – in *Caspiodontornis* at half-way.

A narrow plate, analogous to that lying anterior to the naso-maxillary fissure in *Caspiodontornis,* occurs in *Phalacrocorax pelagicus,* in which it is however distinctly divided into 3 parts – a median part and two lateral ones posterior to the nasals. Supposedly it belongs to the prefrontal bones and serves to improve the functioning of the hinge. In *Pelecanus onocrotalus* two narrow plates (right and left) are posterior to the nasals, whereas the posterior ends of the premaxillary nasal processes cling directly to the prefrontals. In *Sula bassana* the structure of the posterior part of the dorsal surface of the rostrum is clearly different from that of the prefrontals; neither are there any traces of the sutures between particular bones of the posterior part of the rostrum (nasals, intermaxillary nasal processes, prefrontals). In *Caspiodontornis* the frontal surface and the surface of the rostrum lie on the same plane, which however may be due to the deformation of the skull, whereas in the pelican the former is slantingly raised in relation to the surface of the rostrum, similarly to that in the gannet and cormorant. The frontal surface of the skull of *Caspiodontornis* is relatively short (anteroposteriorly, Table III: C). The poorly marked transverse fronto-prefrontal suture, running approximately at the level of the line connecting the mid-orbits, can be seen on the dorsal surface of the skull of *Caspiodontornis.* This suture occurs in the same place in *Pelecanus onocrotalus.* In *Phalacrocorax pelagicus* the suture extends at the level of the posterior edges of the orbits, immediately behind the postorbital processes. In *Sula bassana* the hardly marked suture is also in a line of the mid-orbits. In *Anhinga* it is poorly seen somewhat posterior to that line. In *Caspiodontornis* the length of the prefrontal along the midline comes to 28 mm. The dorsal surface of this bone is damaged.

Table III

Comparison of skull shape indices in *Caspiodontornis,* fossil Odontopterygiformes (calculated on the basis of drawings in a work by HARRISON & WALKER 1976) and some Recent Pelecaniformes. Index of the height of the rostrum at its basis relative to its length – A. Index of the smallest breadth of the rostrum relative to its length – B. Index of the breadth of the frontal area relative to its length – C

Species	A	B	C
Caspiodontornis kobystanicus ASLANOVA et BURCHAK-ABRAMOVICH, 1982	7.9	22.6	72.2
Other Odontopterygiformes			
Odontopteryx toliapica OWEN, 1873	28.1	–	78.3
Macrodontopteryx oweni HARRISON et WALKER, 1976	–	–	70.0
Pseudodontornis longirostris SPULSKI, 1910	17.1	–	76.5
Osteodontoris orri HOWARD, 1957	15.5	–	–
Dasornis londinesis OWEN, 1869	–	–	89.0; 80.9
Recent Pelecaniformes			
Phalacrocorax pelagicus PALLAS, 1811	15.3	–	–
Sula bassana LINNAEUS, 1758	18.1	–	63.0
Anhinga anhinga LINNAEUS, 1766	13.3	–	–
Pelecanus onocrotalus LINNAEUS, 1758	6.8	8.2	68.4

The structure of the posterior part of the dorsal surface of the rostrum is specific and we failed to find its analogies in other groups of fossil and Recent birds. In *Caspiodontornis* the naso-prefrontal fissure is well defined as a transverse cleft up to 50 mm long. Both nasals protrude 5 mm posteriorly beyond the naso-prefrontal fissure. A somewhat lowered triangular plate lies between the medial edges of the nasals (see above). The medial edges of the nasals form a ridge, up to 4 mm in height, above that plate. In each nasal the medial and posterior edges are convex, passing gradually one into the other, the lateral edge being straight and the bone longitudinally straight and transversely gently-slantingly convex. The nasal gradually tapers anteriorly. The narial aperture lies in the lower part of the lateral slant of the nasal. The nares are slit-shaped. The exact measurements of the nares are difficult to establish because of the indistinctness of their borders. Provisionally, they are 10x6 mm. The distance of the posterior edge of the nares anterior to the naso-prefrontal fissure is ca 15 mm.

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