

# The Group of the Ganopristines

by

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{p. 127}

Among the groups of selachians nowadays vanished, those of the ganopristines (Arambourg, 1935) or “sawfishes with enameled rostral teeth” is one of the more curious by its affinities and by the diversity of the types that it includes.

By their general form, known according to the magnificent specimens of *Sclerorhynchus* from the Cretaceous of Lebanon (Woodward, 1889 and 1892; Hay, 1903), these fishes approach all together *Pristophorus* and *Pristis*. As among them, their body is lengthened, narrow, depressed as among *Pristis*, with wide pectoral fins. The head is prolonged by a long flat rostrum, adorned on each side with a rank of teeth directed perpendicularly to its axis and situated in the horizontal plane. Their skeleton is constructed upon the same plan as that of the *Pristis*. The structure of the pectoral fin is, in particular, quite typical in this regard. They are in effect triangular and extend widely {p. 128} in the plane of symmetry of the body, to the rear up to the level of the pelvics, in front up to the level of the posterior region of the head. They are bound to this development and to this form of the distal lengthening of the propterygium and of the metapterygium disposed symmetrically on all sides of the scapula articulation and lay closely on the body, as among the rays, *Rhinobatids* and *Pristis*. It is a characteristic anatomical structure that puts in opposition these last or “Plagiostoma” (Garman, 1913, p. 257) in the other selachians (squalids, pristiophorids) or “Antacea” among which the pectorals are free and anatomically asymmetrical. The vertebral column is formed from vertebrae of the tectospondyl type and that resemble much more those of *Pristis*, but they are perceptibly less thick. The rostral teeth are, contrarily to those of the Tertiary and living Pristidae, covered, as in the jaws, with a thin layer of enamel; they are simply fixed in the tissues by ligaments, and they approach in this manner those of *Pristiophorus*. {p. 129} On the contrary, the rostrum is formed by three cartilaginous bands encrusted with calcite, as those of *Pristis*. This last character is joined to those furnished by the structure of the fins, in order to confirm, as it was indicated by Woodward, the systematic position of these fishes among the Pristidae. But by the structure and the mode of fixation of their rostral teeth they correspond, on the plan of evolution, to a degree of specialization less narrow than that realized by the species of the genus *Pristis* and its allies. This state, in a certain way “primitive” for this fossil group, is manifested also by the very great diversity of the forms that it includes and one must note, moreover, that these are all localized in the Upper Cretaceous while the true “*Pristis*” seems only to first appear in the Eocene.

Generally the only remains of ganopristines preserved by fossilization are the rostral teeth that one finds most often isolated: the beautiful skeletons from Lebanon are one exception. However, the rostra of *Onchopristis numidus*, nearly complete and lined with their teeth, have been noted in the Cenomanian of Egypt by Stromer (1917).

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The rostral teeth of ganopristines belong to rather diverse morphological types, generally described under particular generic names, but of which the true nature has long been misjudged. It is this that Gervais (1852) had attributed to a new reptile, *Onchosaurus*, these come from the Senonian of the Paris Basin, while later Priem (1908) attributed them to a fish of the family Esocidae. The teeth described by Leidy under the name *Ischyrhiza* have been at first attributed to the teleost family Elopidae (Woodward 1901). *Gigantichthys* {p. 130} (= *Titanichthys*) has been compared by Dames (1887) to the teeth of the genus *Enchodus*. It has been necessary for the discovery, with teeth in place, of rostra of *Onchopristis* and that of complete skeletons of *Sclerorhynchus* in order to establish the actual origin of these organs and the relationships of the fishes to which they belong.

In spite of their great diversity in appearance, the rostral teeth of the ganopristines present, however, an ensemble of characters that permits them to be identified unquestionably. They are, in effect, formed in two parts always very distinct.

1st. A crown, very variable in form according to the genera, but generally thin, more or less compressed dorsoventrally, always covered with enamel, and of which the anterior and posterior edges are sharp, at least toward the distal extremity;

2nd. a base or root, of variable length, deprived of enamel, enlarged at its base, which presents notches or grooving more or less accentuated and more or less numerous, that corresponds probably with the insertion of the ligaments serving to fix it upon the rostral cartilage; this base is concave on its proximal face that bears moreover the opening of a narrow pulp canal.

Contrarily, in effect, to those of the living *Pristis*, these teeth are not deeply embedded in the alveoli, but insert only in the simple grooves of the cartilage or in the integument; the form of their base, their mode of fixation by ligaments, drawing near to those of the Pristiophoridae; they are distinguished from them, however, by their much more reduced pulp canal, their completely ossified base and middle.

The oldest type described is that which has been made allusion to above and that Gervais has named *Onchosaurus*. It is a matter of a tooth of which the crown, relatively little developed, is roughly triangular, compressed as that of all the ganopristines; it is born upon a pedestal two or three times longer than it, {p. 131} deprived of enamel and of which the base enlarged strongly in a wide expansion of elliptical section, furrowed upon all the surface of its proximal third by numerous and deep grooves (See Pl. III, fig. 1, 1a, 1b).

Other teeth of the same type have, later, been discovered in Egypt and described by Dames (1887) under the name of *Gigantichthys pharao* (See fig. 2 and 2a in the text); this last form has been found recently in the Niger Basin (See Pl. III, fig. 6 to 9). I have described in 1935 a third form from the Maastrichtian of Morocco. It seems finally that the teeth from the Cretaceous of New Jersey named *Ischyrhiza* by Leidy (1856) belong to the same group as the preceding, supposing even they are not generically identical to them, and it is to a species of the same genus that one must refer *Dalpiazia stromeri* described by Checchia Rispoli (1933) from the Maastrichtian of Tripolitania.

A second type is constituted by *Sclerorhynchus* from the Cretaceous of Lebanon. The rostrum of these fishes is elongate, narrow and adorned laterally with numerous small teeth with compressed sharp crowns, pointed and recurved to the rear. This enameled crown is immediately supported by a widened base deprived of enamel, shallow and marked with strong furrows disposed radially that, according to the expression of Woodward, giving it, in plan view, an "emaciated" aspect.

Other forms, also from Lebanon, have been attributed to this same genus *Sclerorhynchus* by O. P. Hay (1903) under the name of *S. solomonis*, *S. hiram* and *S. sentus*. We have the occasion to return later to their subject.

A third type has been distinguished by Stromer (1917) under the name of *Onchopristis* for a form from the Cretaceous of Djoua (Sahara), earlier attributed by Haug (1905) to the genus *Gigantichthys* under the name *G. numidus* and found again later on associated with fragments of the rostrum in the Cenomanian of Egypt. It is a matter of a form of great size, but of which, morphologically, the rostral teeth approach those of *Sclerorhynchus*: their pointed crown, elongated, recurved, is covered with enamel up to the level where the base enlarges into a low pedestal strongly furrowed with radial canals that give to these expansions, viewed from above, a typical emaciated aspect.

In 1930, Weiler believed the genus *Schizorhiza* for the teeth from the Maastrichtian of Egypt, formed by a triangular, enameled, very compressed crown {p. 132} and with sharp edges, supported by a pedestal two or three times longer without enamel, strongly furrowed and deeply bifid (see fig. 6 in the text). In such abundant teeth in certain Maastrichtian or Danian levels of Morocco, of southern Tunisia, and of Aurés (Laffitte, 1939). They have been found also in the Maastrichtian of Tripoli (Serra, 1933) and of Nigeria (White, 1934).

Recently Weiler (1935) described, under the name of *Marckgrafia*, teeth from the lower Cenomanian of Egypt that seems to belong also to a group of ganopristines and resemble in certain regards those of the genera *Onchopristis* and *Sclerorhynchus*. These teeth are, in effect, formed by an enamel crown supported by a widened pedestal. The crown is a little compressed dorsoventrally with a ridge on the anterior and posterior edges; it is slightly recurved ventrally. The pedestal is taller than the crown: its section is roughly square and widens regularly toward the base; it is marked, upon all its surface, with strong radial canals and bears on its posterior edge a rather deep furrow that extends upon nearly all its height; its base is concave and bears in its center the outlet of a narrow pulp canal. There is no doubt that it is a matter of the rostral teeth belonging to a fish of the same group as the preceding. They scarcely differ from those of *Sclerorhynchus* that by the more elongated and nearly pyramidal form of their root, in the same way by the ventral curve of their crown. Weiler situated this genus among the pristiophorids, by analogy with *Sclerorhynchus* that Stromer {p. 133} (1917) with doubt attributed to this family, while he places *Onchopristis* among the pristids (1917-1925).

Finally I have myself, in 1935, collected in the Maastrichtian levels of Morocco, the isolated teeth for which I have proposed the name of *Ganopristis*. These teeth have for an essential character their enameled crown, compressed dorsoventrally in the form of a knife blade, sharp toward the point upon the two edges, and supported by a base without enamel, absolutely smooth, with oval contour, strongly notched on the posterior edge. Although found separately, these organs to me have appeared to be, without a doubt, only the rostral teeth of a pristid near *Sclerorhynchus* and *Onchopristis*. This opinion is found confirmed, recently, in the course of a trip to Lebanon, where, independently in the discovery of similar associated pieces of rostral fragments effected in the same deposits, I have been able to observe all one series in the collections conserved at Beirut at the American University and the Jesuit College. Among these last, there is one particularly remarkable coming from the Zumoffen collection and of which I give a photographic reproduction, Pl. IV, fig. 1.

It is a fragment of rostrum of 80 mm long of which the proportions: distal width 22 mm, proximal width 27 mm, for a length of 30 mm, indicating a rather slender form, comparable to that of the rostrum of *Sclerorhynchus atavus*. The three cartilages that constitute it are clearly

defined by their line of separation, that of the middle being a little wider than each of the two others. The calcifications with which they are encrusted form a very regular pavement of small hexagonal plates of which the surface is smooth; this reproduces exactly the structure noted by Woodward for the rostrum of *S. atavus*, and by Hay, 1903, p. 399, PL. XXV, for that of *S. solomonis*. One observes no trace of the overlaying dermal elements such as buds or placoid scales. {p. 134} The teeth are remarkably robust: there are about 4 for a length of 1 cm and their total length is 6 mm. Each of them includes a base in the form of a pedestal with the external surface perfectly smooth, of which the section is elliptical; the lower edge is notched in the rear by a deep fissure that is followed by a slight depression upon the posterior surface of the pedestal; a smaller notch is observed also on the anterior edge. The crown, scarcely taller than the pedestal, is formed from a compressed enamel blade, in the form of a penknife blade, pointed, sharp all the length of the anterior edge and in the distal part only of the posterior edge; its axis is in the prolongation of that of the pedestal and perpendicular to the general direction of the rostrum; the curve of the posterior edge is a little more accentuated than that of the anterior edge. These teeth resemble, however, completely, in the proportions and in several morphological details, those that I have described under the name of *Ganopristis*, and there is no doubt that it is a matter of two generally identical forms.

If one refers to the descriptions by O. P. Hay of different species of *Sclerorhynchus* that he distinguished among the forms from Lebanon, one sees that two among them: *S. hiram* and *S. sentus* are alike by the characters of their isolated rostral teeth of which he comes to make mention of. Both, in effect, are provided with rostral teeth formed from a smooth base, surmounted with an enameled crown, compressed and with sharp edges. They are contrary to the other "*Sclerorhynchus*": *S. atavus*, from the Senonian of Sahel Alma, and *S. solomonis*, from the Cenomanian of Hadjoula, among which the enameled crown reposes upon a folded pedestal and has, following the expression of Woodward, a "star-shaped" appearance when it is viewed from above, like those of the teeth of *Onchopristis* or of *Onchosaurus*.

We attach, however, to the genus *Ganopristis* the two forms described by Hay: *S. hiram* and *S. sentus*. The rostral teeth of these last 2 forms are much smaller than those of the new fragment, since one counts from 8 to 10 in a cm and that their length does not exceed 3 mm among *G. hiram*. But the fragments described by Hay correspond to the proximal portions of the rostra of small sized individuals; it is possible that, on the contrary, our fragment corresponds to a region near the distal extremity of a rostrum of a much larger individual; this would explain the difference in dimensions of the teeth. The question of size cannot, however, interfere from the point of view of the specific identification of these forms. But one must note that *S. sentus* presents, above its rostral cartilages, two bands of osseous dermal shields [buds?] that are missing from the others and are sufficient to distinguish it specifically. Continuing the form of rostral teeth of which the crown is not only strongly arched as among *S. hiram* but even directed to the rear forming a 45 degree angle with the axis of the pedestal, {p. 135} while it is perfectly straight in the specimen of the Zumoffen collection.

For these reasons and notwithstanding the repugnance that I try to separate specifically the incomplete fragments, I believe that it is, nevertheless, necessary to designate, at least provisionally, the specimen figured here, under the name of *Ganopristis libanica* nov. sp.; it comes probably from Sahel-Alma.

Anticipating the diversity of the forms of the ganopristines described and the names that have been applied to them, the question is posed about the resolution and about the legitimacy of the various divisions espoused. It is carrying out this that we proceed to attempt.

In the same way it has been said at the outset, only one is known to us the complete skeleton of *Sclerorhynchus atavus* from the Senonian of Sahel-Alma (see fig. 1, B), the rostra and several more or less complete fragments of *S. solomonis*, *Ganopristis hiram*, *G. sentus*, from the Cenomanian of Hadjoula, *G. libanica* from the Senonian W of Sahel-Alma, [and] also the rostrum of *Onchopristis numidus* from the Cenomanian of Egypt (see fig. 3). These diverse fragments indicate to us a rostral constitution, a disposition and a structure of the teeth, that permits us to infer the very great analogy of these diverse animals among themselves and with those which are known only from rostral teeth: *Onchosaurus*, *Ischyrrhiza*, *Schizorhiza*, *Marckgrafia*. It is, however, the morphology only of these last that can serve as a guide.

From the very first *Schizorhiza* by its rhombic crown (see fig. 6), its elevated thin and bifid root, constituted a special type that differs sufficiently from all others for a legitimate generic separation; it includes, moreover, at least two distinct forms, if not three.

By contrast, the others can be grouped into two series:

1st. *Onchosaurus*, *Ischyrrhiza*, and *Dalpiazia* on the one hand, of which the reduced enameled crown is born by a long peduncle without enamel.

2nd. *Sclerorhynchus*, *Onchopristis*, *Marckgrafia*, and *Ganopristis* of which the long crown, enameled up to the base, is born directly by a widened base, folded in the first third, smooth in the remainder.

These differences, are they sufficient to justify their denominations and themselves correspond not simply to different species of one unique genus that, by reason of priority, must be called *Onchosaurus*?

In reality most of these types are represented each by diverse forms, easily distinguishable and stratigraphically localized: {p. 136}

*Onchosaurus*, for example, include a European form: *O. radicalis* from the Maastrichtian from the Paris Basin; two African: *O. pharao* from the Senonian of the Libyan desert and from the Cenomanian-Turonian of the Sahara, *O. maroccanus* from the Maastrichtian of Morocco.

The American forms described by Leidy under the name of *Ischyrrhiza* are very close to the preceding by the ensemble of their general characters; they seem to be distinguished from them only by their pyramidal smooth peduncle presenting only some deep folds on its proximal part and by their slightly excavated base, deeply notched in the front and rear.

The teeth described under the name of *Dalpiazia stromeri*, from the Maastrichtian of Tripolitania, can be distinguished, as one can judge by the figures below (see also page 142), by nothing essential from those of *Ischyrrhiza*: they are formed with same pyramidal smooth pedestal, slightly folded, deeply notched and nearly bifid at its base.

*Sclerorhynchus* includes, as we have seen, two distinct forms: {p. 137} *S. atavus* from the Senonian of Lebanon and *S. solomonis* from the Cenomanian of the same region.

*Onchopristis* presents, by the constitution of its rostral teeth, the greatest relationship with *Sclerorhynchus* from which it scarcely differs, basically, only by the great size of the known specimens. However, its barbed pointed crown, sharp to the distal extremity only, can, in a strict sense, justify its preservation.

*Marckgrafia*, which is represented by a single form, is distinguished also from all the other types by its elevated and pyramidal pedestal joined to a thick and slightly compressed crown.

*Ganopristis* with *G. leptodon*, *G. hiram*, *G. sentus*, and *G. libanica* constitute a generic separation admissible (grouping several very distinct forms among them) and characterized by its short and smooth pedestal.

It seems, however, legitimate, in the actual state of our knowledge to conserve for the ensemble of ganopristines, the following generic separations: *Sclerorhynchus*, *Marckgrafia*, *Onchopristis*, *Ganopristis*, *Onchosaurus*, (*Ischyrhiza*), *Schizorhiza*.

Finally, in this series of forms, we will add a new one coming from Morocco:

*Ctenopristis nougareti* nov. gen., nov. sp.  
(Pl. II, fig. 4., 4a, 4b, 4c, 5, 5a, 5b, 7.)

This form is represented only by isolated teeth that are abundant at most Maastrichtian phosphate levels in Morocco. The crown is formed by a long and narrow blade of straight enamel, extremely compressed dorsoventrally, of oval section with a sharp ridge upon its two edges (see fig. 11). No specimen is complete by reason of the fragility of these {p. 138} organs, but it is evident that their total length, which can attain 3 to 4 centimeters, is equal to about six times the width of the base. This crown is inserted very obliquely upon the root with the axis with which it forms an angle of about 20°. This last, deprived of enamel, is very low, scarcely equal in height to half of the anteroposterior width of the crown toward its insertion; it is very compressed, of nearly rectangular section, except for the anterior edge that is slightly convex, of general parallelepiped form, smooth in its distal part, rugose in its proximal half; its proximal face (fig. 11c) is rather strongly concave, limited by an irregularly crenulated and interrupted in the rear by a strong notch. One observes, in the bottom of the cavity, the opening of a narrow pulp canal. The junction between the root and the crown is marked by a bourrelet of salient and irregular enamel, forming a point in front.

The histological structure is identical to that of the teeth of *Ganopristis* and *Onchopristis*: the base is formed from vasodentine, while the crown is constituted with compact dentine disposed in layers parallel to the edges, with a central pulp cavity, sometimes subdivided, and from where radiate the very fine canals, normal to the layers of dentine (see Pl. IV, fig. 7), the layer of enamel is very thin.

There is no doubt that these organs are the rostral teeth of ganopristines. The great obliquity of the crown upon the root may make one think of placing it with the teeth of certain *Ganopristis*, such as *G. hiram* from Lebanon; but the feebleness of the root and its form, in the same way the characters of the crown, show that it is a question, on the contrary, of a type entirely peculiar and completely distinct type from those of the same group. The juxtaposition [of] the length of the rostral edges of the long and narrow lamellar forms by the crowns of these teeth must give the rostra of these animals an entirely peculiar comb-shaped appearance (fig. 12). It is for recalling this peculiarity that we will name it *Ctenopristis* ( ) comb, ( sawfish of the sea) this generic level, and we dedicate the species to the memory of Mr. Nougaret, mine owner {p. 139}, who was, under the direction of Mr. A. Beaugé, the principal prospector of the Moroccan phosphates.

It is a matter consequently of all one series of forms that it is possible to group around several types. These, in their ensemble, are connected to the Pristidae, but one series of common characters that are special to them, notably the presence of enamel upon the rostral teeth, justify uniting them, in the same way as I have proposed in 1935, in a special group or subfamily, as the Ganopristinae.

Stratigraphic Distribution of the Ganopristines

The true pristids appear only in the Eocene while the ganopristines are known since the Cenomanian. Most among them seem localized to the Upper Cretaceous in Syria and North Africa, where it is abundant, as well as in the Paris Basin and North America. It is, however, not impossible that certain [ones] have been able to survive locally up to the debut of the Eocene: each one of the species attributed by Leidy to the genus *Ischyrrhiza* coming from the Eocene of North Carolina. However, this stratigraphic indication needs to be confirmed, because it is a question then of a unique and exceptional case, while all the other known ganopristines come from the Upper Cretaceous.

We give, in bringing to a close, the key to different genera and the succinct diagnosis of the diverse types.

### Diagnosis of the Genera and Species of Ganopristines Subfamily Ganopristinae

General form and characters of *Pristis*. Body depressed, furnished with wide triangular pectorals united at their base to the sides of the body, extending in front beyond the branchial orifices because of the distal prolongment of the propterygium. Head furnished with very short prepalatine cartilages. Rostrum lengthened, depressed, formed from three cartilages encrusted with calcium. Rostral teeth include a base formed of vasodentine and a crown formed of compact dentine, covered with enamel; base generally enlarged, concave on the proximal face where opens a narrow pulp cavity. These teeth are not implanted in alveoli and are simply fixed in the integument by ligaments.

Upper Cretaceous of Syria, North Africa, Europe, North America. Eocene (?) of North America.

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#### 1. Genus *Sclerorhynchus* Woodward 1889

Entire skeleton known. Rostral teeth compressed dorsoventrally. Crown enameled up to the base, trenchant on the two edges and recurved to the rear; born by a radially folded pedestal and star-like aspect.

Species:

*S. atavus* Woodward 1889, fig. 1B-2C. Senonian of Sahel-Alma. Elongate rostrum, 5 times longer than wide at the base. Rostral teeth arched to the rear, pointed, trenchant.

*S. solominis* Hay, 1903, Cenomanian of Hadjoula (Lebanon). Wide and short rostrum, about 3 times longer than wide. Rostral teeth directed to the rear and present in the middle of the crown a sudden widening of the diameter forming a shoulder behind which the distal part of the tooth is recurved to the rear; anterior edge trenchant.

It is moreover with some doubts that I maintain provisionally this species in the genus *Sclerorhynchus*, not being able to observe personally the holotype of Hay. The description of the rostral teeth (unfortunately too short in order that their structure become evident upon the

author's plate) is, in effect, the following: "These teeth have a stellate base, as in *S. atavus*, and they appear to have been directed somewhat backward. For some distance beyond the base, for one third or one half of its length, the tooth is terete; then the diameter is suddenly increased, forming a sort of shoulder. The remainder of the tooth is gently curved backward slightly flattened, and brought to an edge on the convex border. It is apparently only the distal portion of the tooth which is enamelled." This is a structure recalling that of the teeth of *Onchosaurus* and it might be, consequently, that the species described by Hay belongs to this last genus.

## 2. Genus *Marckgrafia* Weiler 1935

Only rostral teeth known. Crown little compressed dorso-ventrally, slightly recurved toward the base, with a ridge on the anterior and posterior edges. Pedestal higher than the crown, enlarges regularly toward the base, with strong striations and a deep furrow upon nearly all its height.

Species:

*M. libyca* Weiler 1935, fig. 7. Lower Cenomanian of the Libyan desert. Characters of the genus.

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## 3. Genus *Onchopristis* Stromer 1917

Rostrum and rostral teeth only known. Long rostral teeth, enameled up to the base, curved to the rear, compressed and trenchant at the two edges toward the point only that is barbed. Pedestal base with oval section, with surface deeply grooved.

Species:

*O. numidus* Haug 1905, Fig. 3 and 5. Cenomanian of Egypt, Albian? of Djoua (Sahara). Characters of the genus. Posterior edge with several longitudinal ridges. Certain teeth are double barbed.

## 4. Genus *Ganopristis* Arambourg 1935.

Fragments of head and rostra; rostral teeth. Rostral teeth formed from an enameled crown, lengthened and pointed, compressed and trenchant at least on the anterior edge, born directly by a base elevated in the form of a pedestal with oval section, with external surface perfectly smooth and only notched in the rear on the root edge.

Species:

*G. hiram* Hay 1903, Cenomanian of Hadjoula (Lebanon). Fragments of head and trunk. Rostra lengthened 4 to 5 times as long as wide. Rostral teeth with crown trenchant on the two edges and strongly inclined and recurved to the rear. The magnificent holotype figured by Hay

(1903, pl. XXVI, fig. 1), shows the typical structure of the pectorals, of the branchial arches and of the head.

*G. senta* Hay 1903, Cenomanian of Hadjoula (Lebanon). Fragments of elongated rostra, of proportions analogous to those of *G. hiram* furnished upon one of its faces with two ranks of small emaciated placoid [denticles]. Recurved rostral teeth have a resemblance to those of *G. hiram* or *S. solomonis*; but with an apparently smooth pedestal.

*G. libanica* nov. sp. (Pl. IV, fig. 1), Senonian of Sahel-Alma (Lebanon). Elongate rostra, of proportions analogous to those of the preceding. Rostral teeth straight, with crown hardly higher than the pedestal, in the form of a blade of a sharp scalpel on its two edges.

*G. leptodon* Arambourg 1935 (fig. 8, and pl. IV, fig. 2, 2a, 3, 3a, 3b, 3c, 6). Maastrichtian of Morocco, Danian of southern Tunisia and of the Aur...s. Isolated rostral teeth. Same general characters as those of the preceding species but crown more elongate (about two times higher than the pedestal); trenchant anterior edge upon all its length; posterior edge trenchant in its distal half only, the proximal part being rounded and bearing five or six fine ridges parallel to the axis.

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5. *Onchosaurus* Gervais 1852  
(Syn: *Titanichthys*, *Gigantichthys* Dames 1887.)

Only rostral teeth known. Characterized by their crown, enameled, triangular, compressed, relatively reduced, supported by a long pedestal itself compressed and deprived of enamel. This peduncle widens in its proximal part into a wide pedestal with sub-rectangular or oval section of which the external surface is grooved by deep radial channeling more or less numerous.

A. pedestal simply concave, covered with very numerous channeling:

Subgenus: *Onchosaurus s. str.*

Species:

*O. radicalis* Gervais 1852. (Pl. III, fig. 1, 1a, 1b, 1c). Senonian of Meudon and Touraine (France). Very compressed teeth, reduced crown, with angles blunt or absent. Peduncle long, very compressed, narrow distally with posterior edge convex; pedestal rapidly enlarged, ornamented with numerous and fine radial channeling.

*O. pharao* Dames 1887. (Fig. 4 and pl. III, fig. 6, 7, 7a, 7b, 8, 8a, 8b, 9, 9a, 9b). Senonian of Egypt, Cenomano-Turonian of Niger. Peduncle narrow distally, of which the flattened posterior edge is strongly excavated by a long furrow issuing from the enlarged base. Crown relatively little developed, angular and sometimes barbed on its two proximal extremities.

B. Teeth with pyramidal peduncle, smooth, ornamented only with some large folds in its distal part. Base nearly bifid, very strongly notched by two furrows notching deeply the anterior and posterior edges of the peduncle:

Subgenus: *Ischyrhiza* Leidy 1856  
(= *Dalpiazia* Checchia Rispoli 1933)

Species:

*O. mirus* Leidy 1856. Cretaceous of New Jersey. Thick rostral teeth with a slightly compressed. Massive short pedestal, very strongly notched at the base. Numerous little and weakly marked channels. Type of subgenus.

*O. antiquus* Leidy 1856. Neuse River, North Carolina (Eocene?). These two forms are difficult to separate. We give in fig. 10 the drawing of a specimen of *I. antiqua* in the Collection of Paleontology of the Museum and pl. III, fig. 13, 13a, photo of the same specimen.

*O. stromeri* Checchia Rispoli sp. Fig. 9. I refer to this same subgenus the type of *Dalpiazia stromeri* Checchia Rispoli 1933, from the Maastrichtian of Tripolitania that is distinguished particularly from the American fossil {p. 143} by the more compressed form of its crown and recalls *O. pharao* by its crown and by its enlarged and furrowed base.

*O. maroccanus* (Pl. III, fig. 2 to 5). It is also to this same group that must be referred *O. maroccanus* Arambourg 1935, from the Maastrichtian of Morocco and of which here is the diagnosis. Relatively large crown, lanceolate, trenchant on its two edges, with very marked and salient barbs in the front and in the rear. Compressed peduncle enlarges gradually into a raised pedestal with sub-rectangular section, ornamented proximally with a number of relatively weak large channels; base deeply notched in front and in rear.

Genus *Schizorhiza* Weiler 1930.

Rostral teeth only known. Crown in the form of a rhombic or equilateral triangle, compressed, with trenchant edges, supported by a peduncle two times as high as it, enlarges gradually toward the base. This peduncle is bifid up to the base of the crown paralleling the plane of symmetry of this last; the external surface of its two halves bear a series of channels particularly marked in the proximal part.

Species:

*S. stromeri* Weiler 1930, upper Senonian of Egypt and of Nigeria. Rostral teeth in the form of a equilateral triangle, sometimes with the 2 angles of the base prolonged to salient recurved points. Line of separation of the enameled crown and the peduncle coinciding nearly with the base of the triangle. Compressed crown, with trenchant edges.

*S. weileri* Serra 1933, Maastrichtian of Tripolitania. This form differs from the preceding by its crown, a little thicker, relatively higher, the insertion of the peduncle upon the crown corresponds to a curved line situated below the base of the triangle and convex toward the base.

The rostral teeth of *Schizorhiza* are abundant in the Maastrichtian phosphate of Morocco, in the same way the Danian in the Aur...s of south Tunisia; but they seem to belong to a probably different form from the first two although close to *S. weileri* (fig. 6 and pl. III, fig. 10, 10a, 11, 11a, 11b, 12, 12a, 12b). Their crown is much more compressed, of plainly rhombic form with angles of nearly 90°, with sharp and trenchant edges. The line of separation of the enamel is straight, parallel to the transverse diagonal of the crown and corresponds to the level where the peduncle is narrower. Deposit III of the three phosphate basins of Morocco. Vicinity of Metlaoui (Cha'ne du Zerf). Aur...s, Danian of Ahmar Khaddou (Irzar Imezouchen).

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Genus *Ctenopristis* nov.

(Fig. 11-12 and Pl. IV, fig. 4, 4a, 4b, 4c, 5, 5a, 5b, 7.)

Rostral teeth only known. Crown, laminar, long and narrow, very compressed, trenchant on the two edges, inserted very obliquely upon the root. Bourrelet of enamel salient at the base and forming a point in front. Low root, compressed, rugose in its proximal half, with sub-rectangular section; with base notched in the rear and with edge indented.

Species:

*C. nougareti* nov., Maastrichtian of the phosphate basins of Morocco. Characters of genus, only known species.

Key to Genera

I. Rostral teeth with crown more or less elongated and dorsoventrally compressed. Pedestal enlarges toward the base and extends beyond broadly the crown.

1. Elongated crown, directly born by a enlarged pedestal:

A. Channeled pedestal.

a) dorso-ventrally compressed crown, with trenchant edges upon all the length . . . . . *Sclerorhynchus*

b) weakly compressed crown, furnished with a ridge upon each of its edges, slightly curved toward the base . . . . . *Marckgrafia*

c) compressed crown and trenchant to the distal extremity only that is barbed . . . . . *Onchopristis*

B. Smooth pedestal, crown very compressed, trenchant on the two edges . . . . . *Ganopristis*

2. Short crown, born by a long peduncle without enamel, enlarges at its base.

A. Undivided peduncle . . . . . *Onchosaurus*

a) Peduncle strongly striated particularly toward the base, this latter simply notched in the rear and in the front . . . *Onchosaurus s. str.*

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b) Smooth peduncle, pyramidal, bearing only several folds toward the base; this latter strongly notched by two deep furrows lengthened upon the anterior and posterior faces of the pedestal . . *Ischyrhiza*

B. Triangular or rhombic crown, more or less compressed; peduncle garnished by a small number of channels and deeply bifid up to the limit of the enamel: *Schizorhiza*

II Teeth with a laminar crown very oblique and furnished with a large bourrelet of enamel at the base. Pedestal very short, with surface in part smooth, in form of parallelepiped, no projection at the base of the crown . . . *Ctenopristis*.

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### Legends for Plates III and IV

#### Plate III

Fig. 1. *Onchosaurus radicalis* Gervais. Rostral tooth from the Senonian of Chemillé (Touraine). 1, dorsal or ventral face; 1a posterior face; 1b, anterior face; 1c, proximal face. Natural size.

Fig. 2 to 5. *Onchosaurus maroccanus* Arambourg. Fragmentary rostral teeth from the Maastrichtian of Imin' Tanout (Morocco). Natural size.

Fig. 6 to 9. *Onchosaurus pharao* Dames. Rostral teeth from the Cenomano-Turonian of Niger, 6, dorsal or ventral face of an adult individual; 7, 8, 9, dorsal or ventral faces of juvenile individuals; 7a, 8a, 9a, posterior faces; 7b, 8b, 9b, proximal faces. Natural size.

Fig. 10 to 12. *Schizorhiza* aff. *weileri* Serra. Rostral teeth from the Maastrichtian of Oued Oussen and Koudiat Abbou (Morocco). 10, 11, 12, dorsal or ventral faces x 2; 10a, 11a, 12a, the same, natural size; 10b, 11b, 112b, posterior faces x 2.

Fig. 13. *Ischyrhiza antiqua* Leidy 1856. Rostral teeth from the Upper Cretaceous (?) of North America. 13, dorsal face; 13a, posterior face.

#### Plate IV

Fig. 1. *Ganopristis libanica* nov. Fragment of rostrum from the Senonian of Sahel Alma (Lebanon). x 2.

Fig. 2 and 3. *Ganopristis leptodon* Arambourg. Rostral teeth from the Maastrichtian of Koudiat Abbou and Ksibet-el-Draben (Morocco). 2, 3, dorsal or ventral faces; 2a, 3a, anterior faces; 3b, posterior face, 3c, proximal face. Natural size.

Fig. 4 and 5. *Ctenopristis nougareti* nov. Rostral teeth from the Maastrichtian of Koudiat Abbou and Ksibet-el-Draben (Morocco). 4, 5, dorsal or ventral faces; 4a, 5a, posterior faces; 4b, 5b, anterior faces; 4c proximal face. x 2.

Fig. 6. *Ganopristis leptodon* Arambourg. Transverse section of the crown of a rostral tooth in its proximal half. x10.

Fig. 7. *Ctenopristis nougareti* nov. Transverse section of the crown of a rostral tooth in its middle part. x 20.