

## A NEW SAUROPOD FROM THE JURASSIC OF PATAGONIA<sup>1</sup>

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Thanks to the excellent works of Lydekker and Huene, based principally on the materials which form part of the collections of the Museum of La Plata and were published in its *Anales*, the Cretaceous Argentine dinosaurs, especially the Saurischia, are known, if not completely, at least satisfactorily. In contrast, of the Jurassic representatives of these reptiles in our territory until now we knew not one word. The only information to refer to, and not without some doubt, was that which Piatnitzky summarized (1936, 103) mentioning "bones of a saurian of no less than 5-7m long" in deposits overlying the Liassic of the Pampa de Agnía, Chubut. Fortunately, the site of this discovery was visited in the beginning of this year by one of the geologists from the Dirección de Yacimientos Petrolíferos Fiscales, Dr. Tomás Suero, who not only confirmed the presence of the cited remains, but extracted as many as were

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<sup>1</sup> Cabrera, A. 1947. Un sauropedo nuevo del Patagonia. *Notas del Museo La Plata*, 12: 1-17.

possible and had them brought to the Department in my care at the Museum for study. Examination of the material revealed that they pertained, not only to a saurian in the old taxonomic sense, but to a saurischian of the suborder Sauropoda, of large size, surely more than double that calculated by Piatnitzky.

The fossil was found in the eastern slope of the sierra of Pampa de Agnía, southeast of the Cerro Camerón and some 8 km W-SW of the García Prieto ranch (formerly the Gallina ranch) at the source of a tributary of the Cañadón Puelman. This ranch is accessible by a trail that is part of La Herrería located on National Route 25, 400 km from Rawson. In reference to the horizon, Dr. Suero had the generosity to provide me the following information:

"The remains were discovered in a bed of sandy tuff and bluish gray clay, which form part of a continental sedimentary series mixed with porphyritic conglomerates with partly encrusted round pebbles, and bluish gray cineritic clays with sandy intercalations and clays in lesser amounts. This complex rests on Liassic beds with *Harpoceras subplanatum*, in those not lacking tuffaceous intercalations. The contact between the Liassic and the fossil horizon is concordant, and a gradual change between the two can be observed. On top of the fossil horizon sits, with slight erosional discordance, the agglomerates, breccias and porphyritic strata of the Porphyritic Series, whose age is doubtful based on our observation; it is suspected that it represents middle-upper Jurassic. The age of the continental complex which includes the remains could be, then of uppermost Liassic or possibly Middle Jurassic.

Although the material is very fragile, it is noted in the observable characters that it corresponds to a species of the family Cetiosauridae or Cardiodontidae, if *Cetiosaurus* Owen and *Cardiodon* Owen are truly synonymous, as thought by many paleontologists<sup>2</sup>. The genera of this family, as is known, are from the Middle and Upper Jurassic, not one known with certainty before the Dogger, and if we accept the designations assigned by Huene, this distribution must still be extended to the beginning of the Cretaceous. It has been thought that *Rhoetosaurus*, of the Walloon strata in Queensland, may be from the Lower Jurassic (Longman, 1926, 183), but this seems to me very dubious. In general terms the

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<sup>2</sup> The priority of *Cardiodon* over *Cetiosaurus* has been firmly stated by Lydekker (1889, 245) and by Bush (1903, 96), but I think it opportune to point out that the supposed identity of these two genera is based exclusively on the opinion of the first of these authors, who considered it "highly probable" from the work of the geologist Prestwich (1888, 208) that the remains of *Cetiosaurus* in the Oxford University Museum could come from the same horizon of that of the holotype of *Cardiodon*. In reality, if we are to trust the respective figures, these teeth are different from one that was found with the remains of *Cetiosaurus* which, in the opinion of Owen, is the only one which can be attributed to the genus with any certainty. It cannot be forgotten that Owen was more inclined compare *Cardiodon* with another genus, *Bothriospondylus*, which is not thought to be a cetiosaurid by other authors. It is very adventurous to discuss this point while there are not more complete remains of these genera. Overall, it seems to me preferable to continue using the names *Cetiosaurus* and Cetiosauridae while these synonymies are established on such weak bases. What cannot be accepted in any case is the singular criterion of Huene (1927a, 121) which preserves both names but at the same time within the family Cetiosauridae places the genotype of the same in a subfamily Cardiodontidae. It is evident that it was not an error of the pen, since although later (1929, 115) he corrected the inadequate subfamilial ending, he insisted on this inexplicable incongruence.

Walloon series is considered Jurassic, but there are authors who view them as Upper Jurassic only, and some others extend them to the Neocomian; and if, as it seems, in the region in which *Rhoetosaurus* is found the strata do not contain *Thinnfeldia*, one has to definitely refer this genus to the Middle Jurassic (Bryan and Jones, 1944, 72 and 75). As it were, it is in my opinion highly improbable that the sauropod of the Pampa de Agnía is older than the Middle Jurassic. In reference to its taxonomic position, it evidently pertains to a new species with affinities to *Cetiosaurus*, but whose dorsal vertebrae are less excavated laterally and whose teeth and pubis present some peculiar characters which separate it from the latter, especially if one considers the distance between Patagonia and the British Isles, whose Jurassic fauna pertains to *Cetiosaurus*. Certainly we know very little of the capacity of geographical expansion of dinosaurian genera, but also it should be remembered that, with no more basis, one of the British species, *Cetiosaurus leedsi* (Hulke), has been separated by Huene as the type of *Cetiosauriscus*. It is not possible to know with security, until enough future discoveries permit us to compare characters of the skull and other parts of the skeleton which are for now totally unknown, if in reality they pertain to true genera or only to subgenera.

AMYGDALODON<sup>3</sup> gen. nov.

Type.-*Amygdalodon patagonicus* sp. nov., of the Jurassic of Chubut.

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<sup>3</sup> From the Greek *amygdalos* for almond, and *dont*, for tooth.

Characters.-A genus of cetiosaurid with dorsal vertebrae lacking a spongy interior and without true pleurocoels, which are represented by simple lateral depressions; the pubis is similar to atlantosaurids, and the teeth very similar to *Brontosaurus*, although larger in relation to the size of the animal.

***Amygdalodon patagonicus* sp. nov.**

Type.-Various incomplete vertebrae and parts of others, some fragments of cervical and dorsal ribs, part of a scapula, an incomplete pubis, and four teeth and parts of another three, obtained by Dr. Tomás Suero. Núm. 46-VIII-21-1 of the Departamento de Paleozoología, Vertebrados, del Museo de La Plata. Donation of the Dirección General de Yacimientos Petrolíficos Fiscales.

Locality.-Eastern slope of the Sierra de Pampa de Agnía, government of Chubut (Ul supra).

Horizon.-Almost surely Middle Jurassic.

Description.-For the dimensions of the studied remains, it can be deduced that this reptile, without reaching the enormous size of *Argyrosaurus* and *Laplatasaurus*, was much larger than *Titanosaurus australis* Lydekker, the most abundant sauropod in the Argentine Cretaceous, which reached a length of approximately 9 meters. These titanosaurids are mentioned here solely for the comparison of size, as a simple examination of the teeth of this new species is enough to demonstrate that it has nothing taxonomically to do with these others. The collected teeth include four nearly complete, missing only the tip of the root, as well as the crown of another and two roots lacking crowns. One of these teeth was found implanted

in its alveolus and not completely erupted from what seems to be a fragment of the maxilla, and there is another that has the point worn diagonally and on edge, without doubt for contact with the opposite tooth. In general, these teeth resemble those of *Brontosaurus excelsus* shown by Marsh (1896, lam. XX, fig. 1), but are somewhat narrower and about 50% larger, and bearing in mind that they belong to a smaller reptile than this brontosaur, its dentition had to be proportionally stronger. The crowns of these teeth, compressed laterally, slightly curved inward, and with the edges completely smooth, have the shape of an almond. On both labial and lingual surfaces fine wrinkles diverge from the tip, interrupted frequently and disappearing near the base. Bordering each edge is a narrow and delicate sulcus, more marked on the labial surface, the border of which is obtuse and somewhat thickened. The height of the crown comes to be one and a half times its maximum anteroposterior diameter. The root, which if it were complete should have been at least twice the height of the crown, is notably more narrow than this. In some teeth the diameter is invariable throughout most of the length, while in others it broadens rapidly anteroposteriorly towards the tip while at the same time narrowing in the first third labio-lingually. I am inclined to believe this difference is because some teeth are uppers and some lowers, but it is also possible that they correspond to their more or less anterior position in the jaw. The most complete tooth has the following dimensions: height of the crown, 22 mm; anteroposterior crown diameter, 14.6; transverse diameter, 8.8; height of the root,

ca. 40 (lacking some 7mm of the tip); anteroposterior root diameter, just below the crown, 8.5; maximum labial diameter, 10.5.

Among the remains was found a cervical vertebra missing all the processes except the left parapophysis. The anterior quarter of the centrum is strongly curved downward in a manner reminiscent of, though more exaggerated than, the tenth cervical of *Diplodocus carnegii* described by Hatcher (1901, pl. III). Judging by its size, it is very possible that this vertebrae occupies approximately the same position in the series, although the small parapophysis and its forward position suggest better one of the anterior cervicals. As usual, the centrum is strongly opisthocoelous, with the posterior cavity (whose left border is broken) very narrow, short and deep. The curved region of the centrum is considerably constricted, expanding again near its anterior face, which is convex. The ventral surface is flat, especially in its anterior half where it can be better described as doubly concave, bordered on the sides by a sharp crest which is a continuation of the parapophysis and another median crest emerging from the inferior border of the anterior convexity and disappearing posteriorly so that the ventral surface is formed by two wide and somewhat deep parallel sulci. Apart from a broad and shallow depression on each side of the centrum just behind the parapophysis and on top of the crest which delimits the ventral surface, there is no indication of pleurocoels. The depression does not have well defined margins, and is in reality a result of constriction of the centrum in this region. It cannot be compared, in any way, to the deep and well marked cavities of *Bothriospondylus madagascarensis* Lydekker. The minimum

thickness of the bone between the lateral depressions represents no less than a quarter the width of the ventral surface at the same level, while in that of the *Bothriospondylus* from Madagascar noted in the section published by Thevenin (1907, 5) this same measure is one-ninth. The neural canal seems to be very narrow, less than 10 mm wide. The dimensions of this vertebra are: total length, 258 mm; width of the anterior face, 83; height of the anterior face, 55; width of the posterior face, ca. 110; height of the posterior face, 76.

A left prezygapophysis has also been obtained which seems to be from one of largest cervicals, it is broken at the intersection of the infradiapophyseal and infraprezygapophyseal laminae. Its dorsal surface has a spatulate outline and slightly concave.

Two dorsal vertebrae were obtained, resembling the posteriormost and both with neurapophyses broken at the level of the beginning of the infradiapophyseal lamina. Having found them in fragments, it was seen that the interior of the bone is very compact. Seen in section, its outline is reminiscent of the dorsal of *Cetiosaurus longus* figured by Owen (1875, lam. 10) except its ventral surface is more concave. Its anterior face is flat, and its posterior weakly concave, which is possibly what Owen (1875, 30 note 2) meant by the expression "plano-subconcave vertebrae". The first seems to have been more rounded than the second, which is more elliptical with its long axis oriented vertical, but this is not certain, as the margins of the centrum are somewhat damaged in places. A broad and shallow longitudinal depression lacking well defined borders is present on the lateral surface at the base of the neuropophysis. It is very different from that seen in the figures of

*Cetiosaurus* from Huene (1927b, pl. 15, figs. 5-6), being without true pleurocoels. The width of bone between the two cavities is about half the minimum transverse diameter of the centrum. The neuropophysis, which must have been very tall, occupies at its base the length of the vertebrae. The neural canal is narrow and tall, the infradiapophyseal laminae are separated at their base by a space of 25 mm. The most complete of the two vertebrae has the following measurements: length of the centrum in a straight line between its articular faces, 144 mm; width of the anterior face, 140; width of the posterior face, ca. 136; height of the two faces, 142; minimum transverse diameter at midlength, 89; width of bone separating the lateral cavities, 45.

Two caudal vertebrae were also recovered, one of them, by its shape and proportions, seems to correspond to the middle of the series, mostly because it retains vestiges of transverse processes which, in those sauropods whose tails are known, disappear much more anteriorly. In *Camarasaurus*, whose caudal series consists of more than fifty vertebrae, vestiges of these processes are lost by the thirteenth (Osborn and Mook, 1921) and in *Titanosaurus australis* the same is true. Apart from these characters, this vertebra resembles one of those of *Cetiosauriscus* figured by Woodward (1905, 238, fig. 44) but its articular faces are not elliptical as in the latter genus, but circular as in *Camarasaurus*. Of course, as in most cetiosaurids and camarasaurids the vertebrae is amphicoelous. Its neural spine is broken, only the base is preserved, but it may have had resembled that in Woodward's fig. 43, although there is not the slightest indication of postprezygapophyseal cavities that this figure

seems to indicate. The base of the prezygapophysis is preserved but the postzygapophysis has been broken off. This vertebra has the following measures: length of the centrum, 140 mm; height of the posterior face, 91.5; width of the same, 89.

The other caudal is slightly more posterior, determined by the absence of transverse processes, its articular faces are less rounded and it seems that the neural spine is less elevated posteriorly, which would correspond to a smaller neural canal, but this is not confirmable because that which remains has been dislocated. Its measurements are: length of centrum, 148 mm; height of the posterior face, 93; width of the same, 82.

There is also the distal part of a neural spine which almost surely pertained to one of the anteriormost caudals. Its summit is very broad, very irregularly rugose with coarse excrescences arranged asymmetrically. From below it is very flattened from back to front, with the anterior surface gently convex, while the posterior, between the two incomplete supradiapophyseal laminae, is very flat, but with a slight indication of a vertical keel in the middle.

Of the rib fragments obtained, three are from cervical ribs and ten from dorsal ribs. One of the anteriormost is a tubercular process and the other two correspond to the long and narrow distal portion of other ribs, having been discovered strongly adhered to one side of the cervical vertebra already described. The fragments of dorsal ribs are not large enough to permit description of their important features. It is notable that these were transversely convex on their external surface, corresponding with this the profoundly

grooved aspect of its internal surface. On one of the fragments, which pertains the proximal extreme of one of the first ribs on the left side, the external convexity forms a crest or sharp ridge that bifurcates above forming a branch to the capitulum and another to the tuberculum, similar to the anterior ribs figured by Osborn and Mook (1921, pls. 78-81).

I refer to one of the scapulae a large, oblong fragment of bone which is narrow, concave on one face and convex on the other. However, its fragmentary condition will not permit determination of the side to which it corresponds.

Lastly, an incomplete pubis has been obtained which is missing its proximal extreme and almost all of the posterior lamina for articulation with the ischium. It is from the right side and is characterized by having its distal extreme somewhat obliquely truncated, the posterior lamina descends to some 100 mm from the angle of this extreme and seems the large pubic opening maybe open posteriorly. For that which remains of this bone, its form approximates well that of *Cetiosaurus leedsi* or *Camarasaurus lentus* (Marsh), but the anterior border is notably less concave than in these two species and more so than in *Brontosaurus excelsus* (Marsh, 1896, lam. 36 and 172, fig. 16). If the figures of the pubis of *Cetiosaurus* done by Seeley (1889, 392) and later Huene (1927b, lam. 16, fig 39) are exact, the form of the bone of the animal from the Pampa de Agnía is completely distinct. Its dimensions are the following: distance from the distal extreme to the border of the pubic opening, 515 mm; diameter of the distal end, 212, diameter at the level of the point of insertion of the posterior lamina, 170.

Taxonomic discussion.- If this new dinosaur were not known from more than teeth and a pubis, I would not waver in considering it an atlantosaurid similar to *Brontosaurus* or perhaps even including it within the genus, but upon examination of the vertebrae, whose characters are of considerable importance in the classification of sauropods, I am obliged to place it in the family Cetiosauridae, which according to Woodward (1933) contains those genera with shallow pleurocoels. The lateral cavities of *Amygdalodon* are still less developed than those of *Cetiosaurus* but there are other characters which prohibit placing the new species in this genus. For the present, the teeth are distinct from those of the type material of *Cetiosaurus* at the University of Oxford. I have not been able to see the paper in which Phillips gives an engraving of this tooth this material under the name *Cetiosaurus oxoniensis*<sup>4</sup>, but in

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<sup>4</sup> It is disputable whether this name, adopted by almost all paleontologists, should be conserved or if it should be considered a synonym of the early ones of Owen. As is well known, this illustrious man in 1875 referred the material studied by Phillips to his *Cetiosaurus longus*, protesting, in his characteristic manner, the changing of a trivial name and of orthogenic generic alteration. As it were, what cannot be accepted is that *oxoniensis* is the genotype of *Cetiosaurus*, as some authors have read, since it was not originally included in the genus. It is certain that *Cetiosaurus* was described by Owen in 1841 without mentioning species, but in the following year, busy with this genus he described (1842, 94-101) no fewer than four distinct species: *brevis*, *brachyurus*, *medius* and *longus*. One of these species was the genotype, very possibly *medius*, although the author, referring to basis, made it clear: "It is principally determined on these bones...that the characters of *Cetiosaurus* were first determined". To be able to accept *oxoniensis* as the genotype we have to have the certainty that it is the synonym of one of the four species, but whose original name was invalidated

the of the same published by Prestwich (1888, fig. 112d) fine wrinkles are clearly seen oriented transversely to the long axis of the crown, which is not seen in the sauropod from the Pampa de Agnía, nor do any of the teeth have the "grossen, stumpfen Kerbzacken" which, according to Huene (1927b, 446) are present on the edges of the tooth from the Oxford Museum. On two occasions Owen (1844, lam. 75a, fig. 7; 1875, lamina 9, figs. 2-5) figures the teeth of *Cardiodon*, that genus which many authors consider a synonym of *Cetiosaurus*. In their general form and size they resemble well some of the teeth of *Amygdalodon*, but they have numerous parallel wrinkles from the tip to the base of the crown, and between each of these are numerous short, irregular small wrinkles. None of these features are present in the fossil from Chubut.

Another notable difference between *Amygdalodon* and *Cetiosaurus*, as previously indicated, is the form of the pubis. In the latter genus the ischial articulation, or posterior lamina, is very narrow throughout, reaching the distal extreme, a character Seeley and Huene have represented well in figures of the Oxford University material. In *Amygdalodon*, however, the same lamina descends to within a decimeter of the posterior angle of the distal extreme, having an aspect more like that seen in camarasaurids and atlantosaurids. One pubis similar in this respect is that of *Cetiosauriscus*, but it seems to me impossible to include the dinosaur from Chubut in this genus, characterized by small but well

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somehow. Having looked at these, however, it does not seem to me to be the case.

developed pleurocoels, and apart from which whose pubis has a more concave anterior border is in general less slender.

Another genus which may have some affinities with *Amygdalodon*, although it cannot be confirmed because its teeth are not known is *Rhoetosaurus*, which also pertains to a southern continent. The only species known, *R. browni* Longman, nonetheless presents certain differences; its short and laterally compressed dorsal vertebrae contain somewhat extensive lateral cavities, the caudals are elliptical in cross section, and the pubis, although slender like the Chubut sauropod, has a notably concave anterior border. Also, according to Woodward (1932, 389) *Rhoetosaurus* is included in the Brachiosauridae, which is well removed from the genus here described which, for what can be observed in the studied remains, is a true cetiosaurid. Also unnecessary are comparisons with another large southern sauropod *Bothriospondylus madagascarensis*, which may not be a true member of the genus, but for other reasons, including the large pleurocoels in its vertebrae, its CHAGRINADAS teeth and for other characters (Thevenin, 1907) cannot be classified with *Cetiosaurus* and related genera.

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La Plata, December 12, 1946