IV

RESEARCHES

ON

THE REPTILES

FOUND IN THE GAULT OF THE EASTERN PARIS BASIN

BY

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FIRST CHAPTER

ON THE REPTILE LOCALITY IN THE GAULT OF THE EASTERN PARIS BASIN

In the Paris Basin, east and south of this basin, the Albian terrain forms a continuous band "from the banks of the Oise to the environs of Hirson (Aisne), along the Ardennes, Meuse, Marne, Haute-Marne, Aube, Yonne and up to the Nièvre. North of this basin it was encountered in a sufficient number of surveys so that one could admit that it is represented on this side near Valenciennes and Douai by a continuous series of isolated outcrops; subsequently its presence is noted on the bank of the Wissant and on the interior circumference of the Bas-Boulonnais and the Bray country, in the wells of Meulers at Rouen, and in all the drillings of the center of the basin that the Cretaceous traverses[1]."

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[*] Original citation: Sauvage, H. E. 1882. Recherches sur les reptiles trouvés dans le Gault de l'est du bassin de Paris. *Mémoires de la Société géologique de France*, series 3, 2(4):1-42. Translated by Matthew Carrano, Department of Anatomical Sciences, Stony Brook University, June 2002.

[1] Ch. Barrois: *Mémoire sur le terrain crétacé des Ardennes et des régions voisines (Annales de la Société géologique du Nord*, vol. V, p. 265, 1878). — Cf. Ch. Barrois: *Sur le Gault et sur les couches entre lesquelles il est compris dans le bassin de Paris (Ann. Soc. Géol. Du Nord*, vol. II, 1874).

In the first studies on the Cretaceous terrain, Mr. Charles Barrois reunited the Aptian and Albian in the same stage under the name Gault[1] after the examples of Ewald, von Strombeck, Credner, and Schlüter. Mr. Barrois has since maintained the separation between the two stages; for him, the Aptian as Orbigny extended it corresponds to the *Pebble Beds* of Godalming, Upware, Farringdon and Potton in England and to the *Lower Greensand* above the *Pebble Beds*. The Albian can be separated into three zones from bottom to top: the *Ammonites mammillaris* zone, corresponding to the *Folkestone Beds* and the upper part of the *Lower Greensand*; the *Ammonites interruptus* zone, corresponding exactly to the Gault of Cambridgeshire and the lower Gault of Folkestone; the *Epiaster ricordeanus* and *Ammonites splendens* zone, which is gullied by the *Ammonites inflatus* beds passing between the Albian and Cenomanian.

The Gault is well known in the eastern part of the Paris Basin due to the works of Messrs. d'Archiac, Hébert, Buvignier, Nivoit, and Ch. Barrois; its very rich fauna has often been studied by d'Orbigny; indeed, Mr. Charles Barrois, without accounting for echinoderms, bryozoans, and sponges, enumerated more than 320 species; of this number only 1/15 were common to the three divisions of the Aptian, such that it must be concluded that these divisions are real and very distinct from one another. Some vertebrates were also recovered in the Gault; Mr. Barrois noted 18 species of fishes (5 *Pycnodus*; 3 *Chimaera*; 4 *Otodus*; 1 *Lamna*; 4 *Odontaspis*; 2 *Sphenodus*; 1 *Myliobates*) in the Albian stage; 3 species of reptiles are indicated in the Aptian, 9 in the Albian, and 1 in the *Ammonites inflatus* zone at the base of the Cenomanian.

To my knowledge, Mr. Charles Barrois is the first to gave a reasoned list of reptiles found in the Gault of the Paris Basin[2].

These reptiles, numbering 10 species, are:

APTIAN: *Megalosaurus* sp.; *Plesiosaurus latispinus* Ow.; *Polycotylus* sp.

ALBIAN. Greensands with *Ammonites mammillaris*: *Megalosaurus* sp. (Louppy in the Meuse, Grandpré in the Ardennes); *Hylaeosaurus armatus* Mant. (Grandpré); *Pterodactylus segdwicki* Ow.? (Louppy, Grandpré); *Ichthyosaurus campylodon* Cart. (Louppy, Grandpré); *Plesiosaurus latispinus* Ow. (Louppy); *Plesiosaurus pachyomus* Ow. (Grandpré); *Pliosaurus* sp. (Grandpré); *Polyptychodon interruptus*, Ow. (Louppy, Grandpré).

NODULES with *Epiaster ricordeanus*: *Polyptychodon interruptus* Ow. (Ardennes and Meuse); *Pterodactylus compressirostris* Ow.

CENOMANIAN. *Ammonites inflatus* zone: *Polyptychodon interruptus* Ow. (Ardennes and Meuse).

Mr. Barrois remarked that some of the reptile bones found in the *Ammonites mammillaris* zone are impregnated with limonite and probably come from the Aptian mineral; they were altered; in particular, such are the remains that must be referred to *Polycotylus*.

Thanks to the kindness of Mr. Barrois, in 1876 I described several of the species found in the Ardennes and the Meuse, and figured what was known then of the megalosaur and *Polycotylus*[1].

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[1] *Sur le Gault (Ann. Soc. géol. du Nord*, vol. II, p. 54; vol. III, p. 23).

[2] *Les reptiles du terrain crétacé du nord-est du bassin be Paris (Bull. scient. hist. et litt. du Nord*, vol. VI, 1875).

Such was the state of the question of the reptiles of the Gault of the eastern Paris Basin, reptiles that were hardly known except by some fragmentary debris, when, by the benevolent intervention of Mr. Albert Gaudry, Mr. Louis Pierson wanted to subject to my examination a very remarkable collection of reptile bones recovered by him in the Gault of Louppy, in the Meuse; this collection included indeterminate plesiosaur, ichythosaur and crocodilian bones and a large part of the skeleton of a megalosaur clearly distinct from the Great Oolite species. Mr. Péron also gave me the friendship to entrust me with the study of the reptiles found in the *Ammonites mammillaris* zone of Grandpré (Ardennes) and Villotte (Meuse). Mr. Charles Barrois communicated to me the reptiles catalogued in his different publications on the Cretaceous of the northeast part of the Paris Basin.

I have just said that the reptile bones recovered by Mr. Pierson were found in the Pentième phosphate locality, commune of Louppy-le-Château (Meuse). It results from the information communicated by Mr. Pierson that, "the megalosaur bones were found in a well dug 10 meters deep in a sandstone that was found mixed with the phosphate beds; the animal was complete, because still other bones were seen that were impossible to reach because of the crumbling of a part of the galleries where the air pockets were produced. All the bones followed one on the other, but were broken by the load that weighed on them. Regarding the other bones, they were recovered in different wells of the same locality, but always at the same depth, rather more than less, because I remarked that the bones were almost never found in the open ones, nor in the wells approaching the beginning of the phosphate banks."

Regarding the locality, Armand Buvignier[2] notes that, "the greensands and clays of the Gault deposited above the Portlandian limestones in the cantons of Varennes, Clermont, Triaucourt, and Vaubecourt, and on the Neocomian terrains in the cantons of Bar and Tevigny (Louppy-le-Château is in this canton), are extended in isolated outcrops at the surface of the Portlandian plateau, east of Vaubecourt and on the right bank of the Aire. This terrain, which occupies a surface of 413 square kilometers, is composed of clay bases resting on the Neocomian stage and covered by greensands and gray or blue clays. The fossils that are found belong to nearly all diverse orders of acephalic molluscs; some serpulids, belemnites and debris of fishes and saurians have been recovered; numerous fucoids have also been recovered. The fossils found up to the present in the greensands of the Meuse department belong to the following species:

"*Fucoids. Diastopora. Alecto granulata. Crustaceans. Serpula filiformis. Serpula indet. Pholadomia moraeana. Panopaea prevosti. Lucina. Astarte. Corbis cardiformis. Cardium. Pinna. Ostrea leymerei. Gryphaea. Exogyra harpa. Anomia. Terebratula moraeana, praelonga, depressa. belemnites.*"

In the same beds as the reptiles that I will describe below, Mr. L. Pierson recovered numerous fossils that, according to Mr. Dr. Trémaux de Rochebrune, belong to the following species:

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[1] H. E. Sauvage: *De la présence du type Dinosaurien dans le Gault du Nord de la France (Bull. Soc. géol. Fr.*, 3rd ser., vol. IV, p. 439, pl. XII, fig. 2, 3, 18786). — *De la présence du genre* Polycotylus *dans le jurassique supérieur et la craie du nord de la France*, Id., P. 435.

[2] *Statistique minéralogique du département de la Meuse*; 1852.

Ammonites lautus Park.
" *tardefurcatus* Leym.
" *serratus* Park.
" *mammillaris* Schl.
" *auritus* Sow.
" *beudanti* Brong.
Hamites attenuatus Sow.
Scalaria clementina d'Orb.
Natica laevigata d'Orb.
" *gaultina* d'Orb.
" *rauliniana* d'Orb.
" *lamellifera* Rochbr.[1]
Pleurotomaria neocomiensis d'Orb.
Phasianella gaultina d'Orb.
Rostellaria parkinsoni Mant.
" *carinella* d'Orb.
Teredo serpuloïdes Rochbr.[2]
Panopaea plicata d'Orb.
Venus vibryeana, d'Orb.
" *rotomagensis* d'Orb.
Opis hugardiana d'Orb.
Trigonia fittoni Desh.
" *aliformis* Park.
Nucula ovata Mant.
" *pectinata* Sow.
Arca carinata Sow.
" *hugardiana* d'Orb.
Mytilus cuvieri Math.
Lima rauliniana d'Orb.
Inoceramus concentricus Park.
Pecten dutemplei d'Orb.
" *raulinianus* d'Orb.
Plicatula radiata Lamk.
Ostrea aquila d'Orb.
" *milletiana* d'Orb.
" *rauliniana* d'Orb.
Rhynconella sulcata Park.
Heteropora digitata Mich.
Serpula sp.
Ostrea aff. *ramosa* Sow.

This clearly Albian fauna is entirely from the lower, or *Ammonites mammillaris*, zone. Of the 50 species that I can compare with the list given by Mr. Barrois[1] I find 23, or 76.6%, in this zone; 22 species, or 73.3%, are found in the *Ammonites interruptus* zone, 12, or 40.0%, in the *Epiaster ricordeanus* zone. There are 10 (33.3%) species in common between zones 1, 2, and 3, 9 (30.0%) between zones 1 and 2, no species in common between zones 1 and 2, and a single species in common between zones 2 and 3; there are 5 species from the list given above that are unique to zone 1, 4 unique to zone 2, and none are unique to zone 3.

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[1] *Natica lamellifera*, de Rochebrune. (Pl. IV, fig. 9.)

N. testa umbilicata, subglobosa, lamellis concentricis imbricatis distantibus ornata; spira obtusa; sutura impressa, anfractibus 4 subdepressis; columella superne callosa, radiatim lamellata.

Long. 0.025; lat. 0.019.

Umbilical shell, subglobose, ornamented with concentric laminae, undulating, imbricating, well-spaced; obtuse whorl formed from four slightly salient towers, cut at right angles, separated by a deep furrow, marginal to the anterior region. Thick columella, covered on the sides with concentric laminae.

It presents a certain analogy with *Natica gaultina*, d'Orb., but differs from it by the laminae of the test, the straight and non-canaliculate towers of the whorl, the callosities of the umbilicus, and the radiating lamellae of the columella.

[2] *Terda serpuloïdes*, de Rochebrune. (Pl. IV, fig. 8.)

T. testa rotundata, brevis, concentrice striatulata, antice subovata, annulata. Tubum praelongum, contorsum, undique concentrice substriatum.

Shell rounded, short, concentrically striated, oval in the anterior part, separated from the tubes by a circular throttling. Tube long, diminishing in diameter and terminating in an obtuse point, circumvented, weakly striated along its entire extent.

Close to *T. requinianus* d'Orb., differing from it by its oval, not indented, and angular form, by the form of the tube and the absence of transverse furrows.

[1] *Mémoire sur le terrain crétacé des Ardennes et des régions voisines*, p. 269.

CHAPTER II

STUDY OF THE REPTILES FROM THE GAULT OF THE EASTERN PARIS BASIN[1].

ORNITHOSAURIA

PTERODACTYLUS SEDGWICKI, Owen[2].
(Pl. II, FIG. 7, 8.)

The presence of the genus *Pterodactylus* in the *Ammonites mammillaris* greensands of the Gault from northeast France is indicated in a certain manner by the discovery of a cervical vertebra made at Louppy (Meuse).

This nearly intact vertebra entirely resembles the element figured by Owen as *Pterodactylus fittoni* or *sedgwicki* (*Loc. cit.*, Pl. II, fig. 18). It is known that these two species, whose remains are mixed at Cambridge, are very close and that their size is the same; they can only be distinguished from one another in that the alveoli are closer together in *P. sedgwicki* than in *P. fittoni*; because of the resemblance to the teeth that I describe below with those of *P. sedgwicki*, I am entirely disposed to refer to this latter species the vertebra that I describe (fig. 8).

This vertebra is exactly the same size as the element figured by Owen, 0.043 m long; the straight ventral surface, as contracted in its median part, presents a weak longitudinal projection anteriorly, the vestige of a hypapophysis; it is slightly indented posteriorly. The slightly tall lateral surfaces are excavated by a furrow between the lateral edge, which is sharp, and the transverse processes. The base of the neural arch is wide and robust; its cross-section is triangular. The neural canal is oval. The very well-preserved posterior articular part advances markedly in front of the marrow cavity, 0.011 m; at its end it presents a sort of rounded pad, under and on each side of which are seen the postzygapophyses. The prezygapophyses are extended anteriorly (fig. 8, 8 *a*, 8 *b*).

Mr. Ch. Barrois also recovered some teeth coming from a pterodactyl the size of *P. sedgwicki* in the *Ammonites mammillaris* zone of Grandpré (Ardennes); except for several slight differences that I will indicate, these teeth entirely resemble the element figured by Owen under no. 11 of plate I of the cited monograph.

These teeth, which unfortunately are incomplete, not one having preserved either the root or the point, are very slightly recurved anteroposteriorly, flattened mediolaterally, and gradually thin toward the apex; one of them is 0.011 m in anteroposterior diameter and 0.007 m in mediolateral diameter. The enamel covering them presents a sort of irregular folding due to the presence of small, very irregular longitudinal folds that are fused and divided without order, thus forming an irregular a network with long and very straight meshes on both sides of the tooth. The width of the folds is the same as that of the depressions between them. The transverse cross-section of the teeth is elliptical, but there is a sharp carina that separates the two surfaces (fig. 7).

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[1] Cf. H. E. Sauvage. *Sur les reptiles trouvés dans le Gault de l'est de la France (Comp. Rend. Ac. Sc.*, vol. XCIV, p. 1265, meeting of 1 May 1882).
[2] *Monogr. foss. rept. Cret. and Purbeck strata. Suppl. no. I, Palaeont. Soc.* 1859.

"These teeth are very similar to those of *Pterodactylus sedgwicki* described by Owen; the only difference is the carina that separates the two surfaces of our teeth, and whose existence Owen did not note in the teeth he described. These teeth thus belong perhaps to a new species, but it should be remarked that the fossils from the Gault and Cambridge are often rather poorly preserved, according to Owen; this carina could therefore have been worn on his samples. A tooth of *Pterodactylus compressirostris* that I discovered in the glauconitic chalk with *Am. inflatus* at Folkestone, and which is in a good state of preservation, presents at its base all the characters assigned by Owen to this species, a regular ellipse with rounded surfaces on both sizes and without carina; but in advancing toward the apex, the tooth gradually presents the characters that distinguish the Grandpré teeth, that is the double carinae. I think therefore that the Grandpré pterodactyl should be considered the same as that from Cambridge[1]."

DINOSAURIA

GENUS *MEGALOSAURUS.*

Preceded in the Triassic by the genus *Teratosaurus*[2], megalosaurs appear to originate via a small-sized species in the time during which the infra-Liassic sandstones of La Moselle were deposited[3]; more abundant in the Inferior Oolite system and in the Great Oolite, they are represented during the Upper Jurassic period, Kimmeridgian and Portlandian, by *Megalosaurus insignis*[1] and *meriani*[2], to be continued in the Wealden, that is the base of the Cretaceous, by a species of great size; this last species, for which the English paleontologists, Mr. Owen in particular, have preserved the name *Megalosaurus bucklandi*, is indeed very close to its congener from the Bathonian system. Phillips also only admitted one species, "The *Megalosaurus bucklandi*," he wrote, "is a great predatory Lacertilian whose remains were found, in England, at Lyme Regis and Wachet (Lias); near Bridport (Inferior Oolite); at Stonesfield (lower part of the Great Oolite); at Enslow Bridge (upper part of the Great Oolite and Forest Marble); at Weymouth (in the Oxford Clay); at Cowley and Dry Sandford (Coral Rag); at Malton in Yorkshire (coralline Oolite); and in Sussex (Wealden). The species was recovered in the Kimmeridge Clay of Honfleur in Normandy, and in the Oolite of Besançon[3]."

As I have shown, with Messrs. E. E. Deslongchamps and Lennier, the Kimmeridgian megalosaur is clearly distinct from Buckland's megalosaur, although it is still only very imperfectly known; it is the same as the Gault megalosaur.

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[1] Ch. Barrois: *Les reptiles du terrain crétacé du N. E. du bassin de Paris (Bull. Sc Hist. Littéraire du Nord*, vol. VI; April 1875).
[2] Huxley: *The Dinosauria of the Trias (Quart. Jour. Geol. Soc.* 1870).
[3] O. Terquem: *Mém. Soc. Géol. Fr.*, 2nd series, vol. V, p. 240, Pl. XII, fig. 1. — P. Gervais: *Zool. Et paléont. Fr.*, 2nd ed., Pl. LXI, fig. 10 to 12.
[1] Lennier: *Études géologiques et paléontologiques sur l'embouchure de la Seine et les falaises de la Haute Normandie*, p. 35, Pl. XI, fig. 7. — H. E. Sauvage: *Mém. Sur les Dinosauriens et les Crocodiliens des terrains jurassiques de Boulogne-sur-mer; Mém. Soc. Géol. Fr.*, 2nd ser., vol. X, p. 10, Pl. I, fig. 1 to 3.
[2] Greppin: *Descript. Géol. Jura Bernois*, Pl. I, fig. 1 to 5.
[3] Phillips: *Geology of Oxford and the Valley of the Thames*, p. 196.

The first mention that I know of a megalosaur at this latter level is due to Mr. Boyd Dawkins, who noted the presence of the genus in the Liassic of Lyme Regis, the Oolite of Dorset, the Kimmeridge Clay, the Wealden terrain and the Lower Greensand of Potton; also Mr. Seeley indicated the discovery made in this latter locality of a skull of a great reptile, probably a dinosaur, but could not make a generic determination of this skull fragment, also it was Mr. Charles Barrois who first noted in an unquestionable manner the presence of the megalosaur genus in the Gault (*Ammonites milletianus* zone, *Ammonites mammillaris* zone) of the Ardennes and Meuse. Indeed, three teeth have been recovered at Grandpré and Louppy with *Am. Mammillaris*. "These teeth," wrote Mr. Barrois, "are strong, laterally compressed and in the form of a saber point; they are recurved and saw-toothed on their edges. The teeth of *Megalosaurus bucklandi*, the only species known by the English naturalists, is very close to those that we possess; we believe them to be different, however; the Gault megalosaur belongs, according to us, to a new species[4]." I was able to study these teeth and note that they indicate a species that, although very distinct from *Megalosaurus bucklandi* from the Great Oolite and Wealden, is similar to *Megalosaurus insignis* from the upper part of the Jurassic terrains[1].

The teeth from the anterior part of the jaw of *Megalosaurus insignis* that resemble the tooth coming from the Cretaceous of Gosau and figured by Mr. Seeley under the name *Megalosaurus pannoniensis*, n. sp[2]. This small tooth, 0.021 m, is recurved like the tooth of *Megalosaurus insignis* to which I compared it. On the anterior edge exist fine, equal serrations that extend only along half the length of this rounded edge, just as the cross-section of the tooth is exactly the same as in typical megalosaurs; the serrations extend along the entire length of the posterior edge.

MEGALOSAURUS SUPERBUS Sauvage.
Mandible.

Only the anterior part of the megalosaur skull being known up to now, I describe the articular part of the mandible, based on an element in the Pierson collection. This piece shows us that in the megalosaur, just as in all saurians and the inverse of what is seen in crocodilians, the complementary* forms only a coronoid process far from the condyle; as exists in saurians, this process must have appressed against the salient process that provides the jugal. The coronoid process is little elevated above the edge that forms the anterior part of the complementary, which is extended rather far anteriorly, its upper edge being on the same level as the medial edge of the dentary.

The articular part of the complementary forms a depressed surface directed posteriorly, partly ventrally and a little medially. Below this depressed surface, the lateral face of the bone is excavated, as is seen in saurians, this excavation is extended onto the surangular. Just as in saurians, a crest borders the complementary posteriorly,

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[4] *Quart. Journ. Geol. Soc.*, vol. XXX, p. 314, 1869.
[1] H. E. Sauvage: *De la présence du type Dinosaurien dans le Gault du nord de la France (Bull. Soc. Géol. Fr.*, 3rd ser., vol. IV, p. 439, Pl. XII, fig. 2, 3; May 1876).
[2] *The reptile fauna of the Gosau Formation preserved in the Geological Museum of the University of Vienna* (*Q. J. G. S.*, vol. XXXVIII, p. 670, Pl. XXVII, fig. 21, 23; 1881).
* "Complementary" probably = articular [MTC].

however less strong than it is in these latter. On the lateral face, the surangular appears to be extended to the end of the complementary, as exists in saurians,.

The restoration of the megalosaur skull given by Phillips[3] shows the process formed by the complementary, the jaw being restored according to the varanid type; if the mandible of Buckland's megalosaur was similar to that of the species found in the Meuse, the process is too elevated and too vertically directed on this restoration.

In the megalosaur from the phosphates, the mandible is hardly thick, only 0.028 m at 0.160 m from the coronoid process, and does not attain more than 0.070 m in height at this point.

Teeth.
(Pl. II, fig. 3, 4, 5.)

As I said previously, in 1875 Mr. Barrois established the presence of the genus *Megalosaurus* in the *Ammonites milletianus* and *mammillaris* zones of the Ardennes and Meuse by the discovery of entirely typical teeth found at Grandpré and Louppy.

The tooth recovered in this last locality is laterally compressed in the form of a saber point. The anterior edge is sharp along its entire length, garnished with fine, serrated denticles; the nearly straight posterior edge is equally sharp and provided along its entire length with serrations of the same size as those of the anterior edge. The cross-section of the tooth is regularly oval; however, the lateral faces are little more compressed near the posterior edge than toward the anterior edge. The surface of the tooth is traversed by fine striations directed apically. The peak is trenchant and acute. This tooth is 0.070 m tall and 0.023 m wide at the base (fig. 3).

Two teeth still in place in the jaw, and forming part of the Pierson collection, show clearly that the enamel serrations are continued down to the base of the tooth, as much on the anterior carina as on the posterior. These teeth, more curved than those just described, have lengths of 0.055 m for one and 0.050 m for the other (fig. 4).

According to Pictet, "in megalosaurs the dental enamel only descends a short distance from the apex[1]." In writing these lines, Pictet evidently had Buckland's megalosaur in view. Indeed, in this megalosaur the serrations of the posterior edge stop well above the base, the tooth being entirely intact besides and still enclosed in its replacement alveolus[2]. Pictet further indicated that in megalosaurs, "the teeth, at their birth, are straight and compressed into a saw-blade on their edges."

I made known, after Messrs. Deslongchamps and Lennier, under the name *Megalosaurus insignis* a species from the Kimmeridgian terrain of Havre and Boulogne whose teeth offer this characteristic that the serrations of the posterior edge descend to near the base; moreover, the adult teeth present all the characters assigned by Pictet to teeth having newly left their alveoli, that is, they are straight. The same characteristic is noted on a tooth from Louppy, so that it is interesting to note the type of alternation of megalosaurs from diverse geological levels, the Wealden species recalling *Megalosaurus bucklandi* from the Great Oolite, and the Gault megalosaur having some affinities in the teeth with *Megalosaurus insignis* from the Kimmeridgian and Portlandian.

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[3] *Geology of Oxford and the Valley of the Thames,* p. 199.
[1] *Traité de Paléontologie*, vol. I, p. 467.
[2] Cf. Owen: *Monog. foss. Rept. Wealden Form.*, Pl. XI, fig. 1.

In the Upper Jurassic megalosaur, the teeth from the anterior part of the jaws are only serrated along a small part of the anterior edge; however, I have noted some teeth coming from the same portion of the jaws on which the serrations are continued very low. For the Gault megalosaur, the serrations are extended to the base in the anterior teeth, both on the anterior and posterior edges (fig. 5).

The characters that I have just indicated are found in the teeth recovered at Grandpré by Mr. Péron.

Vertebrae.

I only know of a few vertebrae belonging to *Megalosaurus superbus*; they come from a young individual and are similar to those of *Megalosaurus bucklandi*.

The dorsal vertebrae, of which only the centra remain, entirely resemble those figured by Phillips[1]. The centrum is strongly excavated longitudinally, as well as on the lateral surfaces. The articular surfaces, markedly rounded (bi-transverse diameter 0.065 m; height 0.068 m) are directed obliquely from top to bottom and slightly excavated; the edge is thin. The ventral surface continues in a regular curve with the lateral surfaces.

A vertebra, perhaps the first caudal, has one of its articular surfaces flat, whereas the other is strongly concave; this vertebra is 0.058 m long; the surfaces are obliquely directed.

The lengths of the vertebrae that I have been able to study are 0.053 m; 0.056 m; 0.058 m; 0.062 m; 0.065 m; and 0.065 m.

Judging by several fragments, the spinous process appears to have been relatively thin; the end of this process is slightly dilated.

I possess only a 0.060 m long vertebral fragment from the sacrum; the cross-section of this vertebra is triangular, the ventral angle being rounded; the lateral surfaces are slightly excavated; this vertebra entirely resembles the element figured by Phillips[2].

One caudal vertebra is 0.075 m long, narrowed in its medial part. The ventral surface is excavated as a whole, as are the lateral surfaces. The oval articular surfaces are slightly excavated, above all in their dorsal part; they are all of both the same form and the same dimensions. The base of the neurapophysis is wide and extended along most of the centrum length, however less than in *Eucercosaurus tanyspondylus* figured by Seeley[3], by forming a crest accentuated above all in the median part. The facets for the chevron bones are rather large and oval; these facets are separated from one another by a narrow space.

This vertebra much resembles that of *Eucercosaurus* from the same level, but differs in the elongated oval and not circular form of the articular surface.

By comparison with the vertebra of *Eucercosaurus*, the vertebra that I describe must come from the posterior part of the tail.

Ribs.

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[1] *Op. cit.*, p. 203.
[2] *Op. cit.*, p. 206, fig. 2.
[3] *On the axial skeleton of* Eucercosaurus tanyspondylus, *a dinosaur from the Cambridge Greensand* (*Q. J. G. S.*, vol. XXXV, p. 620).

The ribs, of which I have only some debris, are similar to those of *Megalosaurus bucklandi*. The anterior dorsal ribs are long; the head presents two extensions for articulation with the centrum and the vertebral lamina; these two rami diverge from one another at a very open angle; the shaft of the rib itself is slightly arched; this rib is 0.027 m thick and presents a salient crest in its median part, so that its cross-section is markedly prismatic.

Clavicle.
(Pl. IV, fig. 2.)

The clavicle greatly resembles that of Buckland's megalosaur; it must be of great size, based on the fragment that I have; indeed, the width of the bone is 0.060 m in its middle part. The pectoral edge is more curved than in *Megalosaurus bucklandi*; the ventral edge is less indented than in this last species; this edge, trenchant in its more medial part, is rounded little by little.

Radius.
(Pl. IV, fig. 1.)

We have the inferior end of this bone, for a length of 0.160 m. The cross-section of the bone is transversely oval, the two diameters being 0.060 m and 0.043 m. The posterior or inferior surface is flat, and the other surface is rounded; however, toward the distal end the lateral part of this anterior surface flattens, whereas the medial portion is rounded. The distal articular surface is 0.110 m wide and curved into a slightly open S-shape, the medial part being much thicker than the lateral; on the posterior surface, near the articulation, a rather wide depression is seen, like in the iguana but relatively shallower (fig. 1, *a*).

Manus.
(Pl. I, fig. 4, 5,; Pl. II, fig. 1.)

The metacarpals are known only from two 0.120 m long fragments, showing the proximal articular surface. This surface has the form of a triangle whose peak is directed medially; it is slightly bent as a whole. The dorsal face of the bone, which is slender and elongate as in crocodilians, is convex, flat near the proximal end, above all toward the lateral face; the medial face is nearly flat.

Mr. Pierson found in a block with some teeth, a femur, fragments of ribs, the tibia and vertebrae, most of a manus and some detached manual bones from the opposite side of an animal that I am authorized to refer to the megalosaur.

This manus (Pl. II, fig. 1), which comes from a still-young individual like all the rest of the bones found by Mr. Pierson in his first excavations, is composed of three digits, probably 2, 3 and 4, this last very incomplete.

The second digit (2), composed of three phalanges, is 0.095 m long. The ungual phalanx *un*, of which only the imprint remains, is long and straight and must have ended in a sharp claw. The phalanx preceding it is rounded on its dorsal surface (*pl.*). The first phalanx, 0.055 m long, has an excavated proximal articular surface; the lateral surfaces are slightly indented; the dorsal surface is flat near the proximal end; the distal articular

surface presents without doubt an articular pulley; near this end, and against the dorsal surface, can be seen a rather deep cavity (*ph.* 2).

I count four phalanges in the third digit (3). The ungual phalanx, much shorter than in the second digit, bears a straight and sharp ungual in the form of a claw (*un*). The third phalanx is shorter, narrower, and a little more convex in its medial part than the corresponding phalanx of the second digit *pl*. The second phalanx, different from the phalanx of the second digit, is 0.028 m long; it is slightly excavated longitudinally; the distal articular surface, a little excavated bilaterally, thus presents an articular trochlea; the proximal articular surface is rounded (*ph.* 3). The first phalanx has a concave articular surface; the proximal articular surface is slightly convex; the superior surface is excavated anteroposteriorly; the length of this phalanx is 0.028 m (*p.* 3).

The fourth digit, whose phalanges are not in place, shows only two phalanges and the end of the metacarpal. The articular head of this bone is widened in an irregular shape, with a salient part near the anteromedial angle (*mt.* 4). The subsequent phalanx, 0.025 m long, is narrowed at one of these ends, which is regularly rounded, the other end being obliquely cut (*p.* 4). The other phalanx, very incomplete, shows that the articular end is cut obliquely to be adapted to the articular surface of the corresponding phalanx (*ph.* 4).

The Pierson collection also includes several detached phalanges coming from a non-adult animal.

One of these bones (Pl. I, fig. 5) belongs without doubt to the lateralmost digit. The dorsal surface, the straightest, is flat and widened at its distal end; the ventral surface is slightly concave in its posterior part, slightly convex, in contrast, in its anterior part. The lateral surface is flat, slightly separated from the ventral surface in its posterior part, and merging with this one in its middle part. The entire ventral surface is excavated. The slightly convex proximal articular end is wider in the ventral part than in the dorsal part (fig. 5). The distal articular end is rounded transversely (fig. 5 *a*).

The bone figured under number 4 of plate I is the first phalanx of the third digit; it is seen in the drawing by its ventral surface. This bone is 0.045 m long; its width in the posterior part is 0.022 m, its thickness is 0.025 m; in the anterior part the width is 0.016 m, the thickness 0.014 m. The dorsal surface is flat, however slightly excavated anteroposteriorly in its whole. The flat medial surface is separated from the dorsal and ventral surfaces by a well-marked edge, above all in the posterior part. The lateral surface is rounded and merges insensibly with the dorsal and ventral surfaces. The distal articular end presents a trochlea (fig. 4 *a*). The wider proximal articular surface is excavated transversely so that the two articular condyles are placed directly on top of one another, continuing the dorsal and ventral surfaces, the ventral condyle being the more salient.

Along with these bones, Mr. Pierson found a bone that I can only refer to the megalosaur with doubt. This bone, figured under number 3, 3*a* of plate III, is 0.045 m long. The clearly quadrilateral proximal articular surface is slightly convex. The distal articular surface presents a trochlea; the lateral condyle, more salient than the other, is less extended dorsoventrally; indeed, the medial condyle is continued as a pulley to behind the lateral condyle, so that in regarding this bone by its ventral surface one sees this condyle along the lateral edge. The dorsal surface presents the two condyles at its anterior end, the condyles separated by a rather deep gorge; this surface is excavated in

its posterior part. The ventral surface shows the largest part of the lateral condyle; it is deeply excavated between this condyle and the posterolateral angle.

Femur.
(Pl. I, fig. 1.)

I was able to study a femur that is 0.500 m long and comes from a still-young individual. This femur greatly resembles that of *Megalosaurus bucklandi* figured by Mr. R. Owen; however, the articular surface for the tibia is rather different in the two species; the tibial edge is more excavated, and the two condyles are separated by a well-marked notch in the species from the phosphates; the lateral condyle is as much extended as the medial, which is more rounded than in the megalosaur from the Great Oolite of England.

The neck supports the trochanter and head of the bone. Semi-spherical in form, turned a little backward, this is the termination of a portion of the end of the bone that is anteroposteriorly, mediolaterally, and dorsoventrally flat; the posterior surface, at the same time a little lateral to this part, is continued with the posterior surface of the shaft of the bone; the anterior surface, at the same time medial, bears the trochanter at its base.

This trochanter is clearly detached and directly follows the anterior surface of the bone; on the medial surface, the neck is rather deeply excavated between the trochanter and the portion that supports the head, whereas on the lateral surface it is nearly on the same plane as the lateral surface of the shaft of the femur.

The second trochanter is situated very high, as is seen in Buckland's megalosaur; the base is extended and reaches to the level of the beginning of the greater trochanter.

Regarding the shaft of the bone itself, the anterior surface, rounded in its superior part, is flattened at the same time as it is widened; distally, it presents a furrow that separates the two condyles. The medial surface, which merges with the anterior surface proximally, is clearly distinct distally and separated from the anterior surface by a salient crest, at the end of which is the inferior trochanter. The posterior surface, flattened proximally, is rounded distally.

As I have said, the distal end presents two condyles separated from the patellar side by a groove that is less pronounced than the groove on the popliteal side. The medial condyle protrudes a little more than the lateral; opposite to that seen in Buckland's megalosaur, in which the medial condyle is much more salient posteriorly than the lateral, in *Megalosaurus superbus* the two condyles are on the same plane posteriorly. The medial condyle is rounded anteroposteriorly and laterally compressed; the lateral condyle, larger than the other, is composed of two parts, one anterior and rounded, the other posterior and detached from the rest of the bone as a wide process; this arrangement is seen in *Megalosaurus bucklandi*.

Mr. Pierson's collection includes the distal end of the femur of another individual showing that the megalosaur from the phosphates reached entirely as gigantic a size as the megalosaur from the Great Oolite. This femoral end is 0.470 m in circumference at the level of the condyles, and 0.033 m in circumference at the shaft of the bone; the lateral condyle is 0.145 m long anteroposteriorly, the medial condyle 0.135 m; at 0.220 m from the distal end, the bone still has a circumference of 0.265 m, with diameters of 0.095 m and 0.085 m; its cross-section at this point is prismatic. The anterior surface is separated from the medial surface by a strongly salient crest, whereas on the lateral side the anterior surface merges little by little with the lateral surface along a rounded edge.

This surface shows a large furrow in its posterior and distal part that separates the lateral surface from the lateral condyle. The distal part of the posterior surface presents a deep depression for receiving the popliteal crest. Just as for the femur described above, the two condyles are seen to extend posteriorly to the same level, so that this character is not due to age; the groove separating these two condyles posteriorly is narrower, but relatively deeper, than in Buckland's megalosaur.

Regarding the upper or proximal part, the megalosaur femur is more similar to that of saurians than crocodilians. In the saurians I used for comparison (*Lacerta ocellata*, *Plestiodon pavimentatum*, etc.), just as in the megalosaur, the femoral neck is directly on the extension of the posterior surface of the shaft, and forms a head slightly detached from the bone; the upper trochanter is separated from the articular head by a rather large and deep notch, with a furrow existing on the anteromedial surface between these two parts. Moreover the orientation of the trochanter is different; whereas this trochanter is anteriorly directed in the megalosaur, it is lateral in saurians. In crocodilians the proximal part of the femur is very different. Saurians lack a second trochanter, which exists in the megalosaur.

In the latter, the shaft of the bone does not present the double curvature seen in crocodilians and also in saurians, although less pronounced; in this regard, the megalosaur femur resembles that of birds.

The distal end resembles that of crocodilians.

Tibia.
(Pl. III, fig. 1.)

The tibia, of which only the proximal end is known, is rather similar to that of *Megalosaurus bucklandi*. This bone is 0.120 m wide near the proximal end. The femoral surface has the form of a curvilinear triangle; the anterior edge is convex, and the posterior edge is concave, above all medially; the articular surface with the fibula is in the form of a rather deep notch. The anterior edge of the femoral surface is straighter than in Buckland's megalosaur; the marked crest that traverses the posterior surface of the bone in this latter species is also seen in *Megalosaurus superbus*; the part situated medial to this crest is strongly excavated, the lateral part being rounded (fig. 1, *a*).

Fibula.
(Pl. I, fig. 2.)

Two distal ends of this bone are known.

At the distal end, the lateral surface is convex, and the medial surface concave near the articular surface, where the bone is dilated; thus at 0.140 from at the articular end, the shaft of the bone is only 0.035 m wide, whereas it attains 0.080 m near the distal part. The articular end itself is rather different from that seen in *Iguanodon*; this surface is narrower, longer, and presents a series of small bumps; on the lateral edge grooves are seen going up for a length of around two centimeters on the shaft of the bone, grooves having to give passage to powerful tendons.

Pes.

Metatarsals. — Although the bone figured under no. 3 in plate I is more slender and more elongated than the metatarsal of Buckland's megalosaur figured by Phillips[1], and resembles more the metatarsal of crocodilians, and the articular surface has much resemblance with those of animals from this latter group, the general analogies are rather with the megalosaurs, above all those offered for the proximal articular surface.

This metatarsal is slender and elongate; its length being 0.230 m, the width of the proximal face is 0.055 m, the length is 0.038 m; the distal surface is 0.045 m at its greatest width and 0.055 m at its greatest length. The shaft of the bone is cylindrical, the surfaces being rounded. The bone is dilated at its proximal end, the articular surface having the form of an irregular triangle whose peak is directed medially; the medial edge is straight, with several grooves that are continued on the ventral surface and are destined for the passage of tendons; the dorsal edge is rounded and continued by a regular curve with the lateral edge; the medial part is extended in a kind of beak, hollowed dorsally by a groove destined for one of the tendons going to the digits (Pl. I, fig. 3 *b*).

Whereas the proximal face is flat, or a little concave, the distal face is inflated and convex. A wide and deep fossa is visible at the end of the dorsal surface, similar to that in crocodilians; the lateral surface is regularly rounded; the ventral surface presents a similar fossa to that on the dorsal surface; a still larger fossa starts the medial edge and must lodge a sesamoid bone (Pl. I, Fig. 3 *c*).

If, as everyone supposes, the megalosaur had digits armed with strong claws, the form of the distal end of the metatarsal must be singularly favorable for wide dorsoventral movements of the digit.

Mr. Péron communicated to me the distal end of a metatarsal found at Grandpré (Ardennes) and indicating an animal of larger size. Indeed, the dorsoventral diameter of the articular end is 0.055 m. The bone is hollowed by a wide medullary cavity.

Mr. Péron recovered in the same locality a fragment of bone 0.090 m long that I am disposed to regard as the proximal end of a metatarsal or an lateral metacarpal. The lateral surface is flat, like the medial surface. The dorsal surface is rounded slightly to be connected with the lateral surface. The articular surface much resembles that figured in the diagram given by Phillips (*Op. cit.*, p. 215, fig. 3); it is slightly concave; the medial and ventral edges are straight; the dorsal edge is rounded to rejoin the lateral edge; this surface is 0.045 m tall and 0.042 m at its greatest width (Pl. III, fig. 2).

Cuboid. (Pl. II, fig. 2). — The affinities between the megalosaur and crocodilians being great for the metatarsal bone, it is necessary regard the bone figured under no. 2 of plate II as a right cuboid[*]. In crocodilians, this bone articulates with the third and fourth metatarsals, whereas in a dinosaur from the scelidosaurid family, *Scelidosaurus harrisonii*[1] from the Liassic, the astragalus, which is very large, contacts the second and

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[1] *Op. cit.*, p. 215.

[*] "Cuboid" = calcaneum [MTC].

[1] Mr. Huxley has provisionally admitted three families of dinosaurs (*On the classification of the Dinosaurians, with observations on the Dinosaurians of the Trias; Quart. Journ. Geol. Soc.*, vol. XXVI, p. 32, 1870). Fam. Megalosauridae (*Teratosaurus, Palaeosaurus, Megalosaurus, Poikilopleuron, Laelaps, Euskelosaurus*). Fam. Scelidosauridae (*Thecodontosaurus, Hylaeosaurus, Scelidosaurus, Polacanthus,* ?*Acanthopholis*). Fam. Iguanodontidae (*Cetiosaurus, Iguanodon, Hipsilophodon, Hadrosaurus,* ?*Stenopelyx*).

third digits[2]. If our manner of seeing is exact, in the megalosaur the cuboid articulates only with a single digit, probably the fourth, the astragalus being in contact with nearly the entire proximal surface of the metatarsals.

The cuboid is large, being 0.055 m wide, 0.045 m in maximum height, and 0.030 m in maximum length.

The surface in contact with the metatarsal is sensibly flat and must be separated from this bone by a relatively thin cartilage. The posterior surface presents, in its median part, a strong crest directed in the direction of its height; this crest separates two concave surfaces, the lateral wider than the other, so that the astragalus must have the same form as in the crocodile, at least in its cuboidal portion. The dorsal surface (fig. 2 *a*.) of the cuboid is regularly rounded, the ventral surface rather deeply excavated; the anteromedial edge is itself indented to deliver passage to tendons whose mark is seen on the proximal part of the ventral surface of the metatarsal.

Phalanges. — The phalanx figured under no. 3 of plate IV (Bar-le-Duc; Pierson collection) comes from a large individual; indeed, it is 0.100 m long, 0.052 m wide at its distal end, and 0.056 m at its proximal end. It is excavated and transversely oval (fig. 3 *a*.). The distal end, also slightly transversely oval, is rounded in the form of a pulley (fig. 3, *b*). The dorsal surface is rounded, and the ventral surface slightly excavated anteroposteriorly; the lateral surfaces are slightly indented. Just as in the crocodile, a deep oval fossa is seen at the end of the lateral edge and near the distal surface. This phalanx, which resembles that of the scelidosaur in its shape, is less robust and more elongated; it does not present the two lateral expansions that are seen near the distal end in this animal.

Another phalanx 0.065 m long was found my Mr. Pierson. This completely preserved phalanx resembles those figured by Phillips (*Op. cit.*, p. 286). The strongly concave posterior articular end is slightly oval. The ventral surface of the bone, flat proximally, is slightly convex along the rest of its extent. The dorsal surface is convex and merges with the lateral surfaces; a depression exists near the distal end.

It is probably necessary to regard the bone figured under no. 4 of plate IV as coming from a young individual. This bone is 0.030 m long. The proximal surface, sensibly quadrilateral in form, is concave; the ventral edge, longer than the rounded dorsal edge, is slightly notched in its median part. The distal articular surface is convex. The lateral surface is flat, the medial surface excavated near the distal end.

HYLAEOSAURUS SP.

(Pl. II, fig. 6.)

Mantell described under the name *Hylaeosaurus armatus*[1] a dinosaur from the Wealden whose skin was covered by bony, non-overlapping plates.

One of these plates was recovered by Mr. Ch. Barrois in the *Ammonites mammillaris* zone of Grandpré, and it entirely resembles that figured by Mantell under

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[2] R. Owen, *Monographs on the British fossil Reptilia from the Oolitic Formations; A monograph of a fossil dinosaur (*Scelidosaurus harrisonii*) of the Lower Lias. Palaeont. Soc.*, 1862.

[1] *A Memoir on the Fossil Reptiles of the South East of England.*

nos. 3 and 4 of plate X of his Memoir. This plates is 0.009 m and 0.011 m wide, oval, and elevated in its center into a sharp point.

CROCODILIA

CROCODILIAN INDET.
(Pl. III, fig. 4, 5; Pl. IV, fig. 5)

With the bones of the megalosaur described above (vertebrae, femur, manus), Mr. Pierson found four vertebrae and two long bone fragments that cannot be referred to the megalosaur.

Indeed, among them the dorsal vertebrae have slightly concave articular surfaces. In contrast, the vertebrae of which I speak have a strongly concave anterior articular surface, and a convex posterior articular surface; these vertebrae are strongly deformed by fossilization.

One of these vertebrae (Pl. IV, fig. 5) is 0.060 m long. The lateral surfaces and the ventral surface are slightly excavated longitudinally. The posterior surface is convex and rounded. The articular processes, thrown posteriorly, are relatively robust and are detached in the form of a pyramid whose base is turned posteriorly; their lateral surface is flat, the ventral surface slightly excavated longitudinally.

These vertebrae recall those of pythonomorphs and still more those of crocodilians, more especially because the two fragments of bone remaining to be discussed are of this last type.

One of these bones (Pl. III, fig. 4) is the proximal part of a femur. This end is 0.065 m wide. The head is well developed and rounded. The entire anterior surface is rounded, however slightly depressed toward the medial edge; the posterior surface is rounded along the lateral edge, with which it merges insensibly, and is excavated along the medial edge.

The other fragment of bone (Pl. III, fig. 5, 5*a*), 0.100 m long, is the distal part of a tibia; the articular and is 0.080 m wide. The proximally rounded medial edge becomes trenchant toward the malleolus; the lateral edge is thin and trenchant along its entire length. The distal articular surface (Pl. III, fig. 7*a*) has greater similarities with that of the crocodile.

LACERTILIA.

DACOSAURUS.
(Pl. II, fig. 11.)

I refer to this genus a tooth recovered by Mr. Péron in the greensands of Grandpré. This tooth, which would be around 0.033 m long if it were intact, is massive and recurved toward the medial surface; the two strongly bent surfaces are separated by a salient carina that reigns along the entire length; this carina is not serrated, but it is noted that the tooth which I studied is slightly eroded; in *Dacosaurus*, the fine and serrated denticles of the salient edge are very faint, and are seen only on teeth in a state of perfect preservation. The cross-section of the tooth is circular at the base and elliptical toward

the apex. The enamel is ornamented with numerous fine folds, between which are seen very fine, numerous and irregular striations that make the enamel appear like chagrine under the magnifying glass.

The mosasaurid family, appearing in the Upper Jurassic period with the dacosaur genus (*Dacosaurus maximus*, Plien.; *D. pimaevus*, Sauvg.), is continued into the Cretaceous of Europe by the genera *Liodon* and *Mosasaurus*; it is interesting to recover a dacosaur near the base of the Cretaceous terrains[1].

ICHTHYOSAURIA.

ICHTHYOSAURUS CAMPYLODON Carter.

(Pl. II, fig. 12; Pl. IV, fig. 6, 7.)

This species, studied by Messrs. Carter[2] and Owen[3], was recovered in France by Mr. Barrois in the *Ammonites mammillaris* zone of Grandpré, Louppy (Meuse), and Villotte, where it seems to be common; indeed, Mr. Barrois recovered no fewer than 70 vertebrae at Grandpré; *I. campylodon* is equally abundant in the Cretaceous of England, from the Lower Greensand (lower Gault) up to the glauconitic Cretaceous of Douvres with *Holaster subglobosus*[1]. It is found in the phosphatic chalk beds of Boulogne-sur-Mer and in the *Ammonites mammillaris* zone of Bar-le-Duc.

Among the recovered elements in this latter locality, I only will mention several vertebrae.

A posterior cervical vertebra is 0.037 m long and 0.060 m tall, the articular surface having 0.060 m (length 100; height 156; width 159). The dorsal surface is sensible flat, the medullary canal being wide; the dorsal edge is nearly straight. The lateral edges are rounded in a regular curve, so that to be strictly accurate there is not a ventral surface. The two articular tubercles for the rib, situated very close to one another, are placed in contact with the anterior edge.

This vertebra is remarkable for its length compared to the two diameters, so that it is still thicker than the vertebrae of *Ichthyosaurus thyreospondylus* Ow. from the Kimmeridgian.

Anterior dorsal vertebrae. — The length of one of these vertebrae is 0.036 m, its height is 0.080 m, and its width is 0.076 m (length 100; height 222; width 214). The same character of massiveness is found on this vertebra. The dorsal surface is excavated. The two lateral edges are reunited by a regular curve; the largest width of the articular surface is found toward the middle of the height. The dorsal articular tubercle for the rib

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[1] Cf. Plieninger: *Jahresheft* II, 1846; V, 1849. — Quanstedt: *Hand. der Petrefactenkunde; Der Jura*, 2nd ed., 1867. — Wood Mason: *On* Dacosaurus *from the Kimmeridge-Clay of Shotover (Quart. Journ. Geol. Soc.*, 1869, p. 218). — R. Owen: *Palaeontology*, 2nd ed., p. 300; *Cretaceous Reptilia, Palaeont. Soc.*, 1851. — H. E. Sauvage: *De la présence d'un reptile du type Mosasaurien dans le formations jurassiques supérieures de Boulogne-sur-Mer (Comp. Rendus Ac. Sc.*, 10 July 1871); *Sur le genre* Dacosaurus (*Bull. Soc. Géol. Fr.*, 3rd ser., vol. I, p. 380; 1873).

[2] *London Geological Journal*, vol. I, p. 7.

[3] *Monograph on the fossil reptiles of the Cretaceous Formations. Palaeont. Soc.*, 1851, Pl. IV, XXI and XXVI.

[1] *Op. cit.*, p. 3.

is placed very high, toward the limit of the upper quarter of the centrum height, very near the anterior edge; the ventral tubercle, situated nearly at the mid-height of centrum, is a little posterior to the dorsal tubercle.

Middle dorsal vertebrae. — The two costal tubercles are moved back, the anterior tubercle being sensibly at the level of mid-height, very near the anterior edge; the very strong posterior tubercle is placed a little posteriorly.

Posterior dorsal vertebrae. — These vertebrae are elongated transversely; the dorsal surface is nearly flat, just as the ventral face. Length 0.025 m; height 0.070 m; width 0.085 m (length 100; height 280; width 340).

Lumbar vertebrae. — A lumbar vertebra recovered at Grandpré (Ardennes) has similar dimensions: length 0.042 m; height 0.112 m; width 0.115 m (length 100; height 266; width 274). The dorsal half of the centrum is triangular, the dorsal surface being entirely flat; the ventral half is rounded. The rib attachments are placed very low and close together.

Anterior caudal vertebrae. — These vertebrae have a slightly triangular shape, like that of *I. thyreospondylus* from the Kimmeridgian terrain; the ventral edge is slightly rounded. Length 0.040 m; height 0.100 m; width 0.155 m (length 100; height 250; width 287).

Posterior caudal vertebrae. — Numerous caudals recovered at Grandpré come from the posterior part of the body; indeed, certain of these vertebrae are only 0.005 m tall; the articular surfaces are circular.

Humerus. — A humerus, found in the *Ammonites mammillaris* zone of Grandpré and forming part of the collection of the Faculty of Sciences of Lille, indicates an animal of large size; indeed, it is 0.160 m long with a maximum thickness of 0.125 m in the proximal part. The articular head is large and rounded, with a slightly transversely oval shape. A crest that rises toward mid-length of the bone makes the lateral part of the humeral head move medially. The lateral surface of the humeral shaft is slightly concave for its whole length, and more excavated toward the distal part; the strongly excavated anterior surface merges little by little with the equally concave medial surface, like the posterior surface. The distal end, slightly convex on the whole, is divided by a weakly marked crest into two parts, moving in opposite directions and serving for the articulation of the forearm bones; this surface is rugose (Pl. IV, fig. 7).

Teeth. — Some teeth similar to those figured by Mr. Owen were recovered in the greensands of Grandpré (collection of the Faculty of Sciences of Lille; Péron collection). One of these teeth is 0.056 m long, the enameled portion is only 0.020 m long. The square base is strong. The enameled part is ornamented with large striations going all the way to the apex; the enamel is reticulated like chagrine, as much on the striations as between them (Pl. II, fig. 12).

Quadrate. — By analogy with an element preserved in the Musée de Boulogne-sur-Mer, and determined by Professor Seeley to be a *quadrate* of the ichthyosaur, I consider the bone represented under no. 6 of plate IV as the quadrate of *Ichthyosaurus campylodon*, the only ichthyosaur yet known in the Gault of the northeastern Paris Basin.

This bone is remarkably robust, although certainly incomplete; it measures 0.100 m tall and 0.114 m wide at its ventral end.

The ventral surface contacting the mandible is very thick (0.095 m), above all in its median part, and rounded principally in the lateral part, which is irregular and presents

crevices and hunchbacked portions; this surface is decomposed into two portions with opposite inclinations, one from dorsal to ventral and from lateral to medial, the other from medial to lateral. In crocodiles and turtles, the articular surface with the mandible is entirely concave; in pythonomorphs (*Mosasaurus, Platecarpus*) this surface is convex[1]; it is the same in the ichthyosaur.

The lateral surface can equally be divided into two portions: one, turned directly laterally, is regularly convex and it is at this level that the bone is thickest; the other, directed posteriorly, is noticeably flat. The medial surface is flat, slightly concave even close to the marked angle that forms the lateral and ventral part of the bone. Above this angle the lateral edge presents a wide surface for articulation with the temporal. The medial edge is relatively thin.

It is known that in the crocodile, the tympanic bone is extended into a process that skirts the temporal scales and forms the lateral part of the auditory canal. In sea turtles, this extension, much shorter and differently shaped, has the same connections; it forms a veritable box, from whose ventral part is detached a strong, downward-directed process for the articulation with the lower jaw.

If it is so in the ichthyosaur as in the turtle and crocodile, in the figured bone I would have only the mandibular portion of the quadrate, which in the sea turtle, for example, forms the large articular process. It has been known since Cuvier that "the tympanic bone of saurians, nearly always reduced into a prismatic stem, is not connected with the other bones to form part of the solid envelope of the head, and seems in the skeleton to be only a pedicle for the lower jaw.[1]" It could not be the same in the ichthyosaur. Indeed, in this latter, "which is characteristic posterior to the orbit and distinguishes it from lizards, this is a wide bone that articulates with the posterior edge of the posterior frontal and the jugal, and goes at its other end to take part in the articular surface that bears the lower jaw. The bone that provides the rest of this articular surface is placed more medially than the preceding one, and is suspended by the mastoid and lateral occipital.[2]" Consequently, the connections in the ichthyosaur are those seen in the crocodile.

PLESIOSAURIA.

PLESIOSAURUS PACHYOMUS Owen[3].

P. pachyomus, from the glauconitic chalk with *Ammonites inflatus* (Upper Greensand) of Cambridge and the lower Gault (Lower Greensand) of the Isle of Wight, was found by Mr. Ch. Barrois in the *Ammonites mammillaris* greensands of Grandpré (Ardennes).

The cervical vertebrae found in this locality greatly resemble the corresponding vertebrae of *P. carinatus* Ow. from the upper part of the Jurassic terrains. The vertebra is

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[1] Cf. Cope: *The Vertebrata of the Cretaceous Formations of the West*, Pl. XXXVII (*Rep. United States Geolog. Survey*, vol. II, 1875).

[1] *Recherches sur les ossements fossiles*, vol. V, 2nd part, p. 234.

[2] *Id*., p. 458.

[3] *Monogr. of the foss.Rept. of the Cret. Form. Palaeont. Soc.*, 1851, p. 64, Pl. XX, XXI.

short, the height being much greater than the length. The articular surfaces, thick around their circumference, are deeply excavated in their central part; the dorsal edge is nearly straight. The ventral surface presents a salient carina, on each side of which are two deep foramina for vessels; this surface is very straight, such that the contour of the articular surface is triangular ventrally. The attachment surface for the rib is very large and oval, occupying nearly the entire length of the lateral surface and most of its height. The suture that delimits the neural arch is only separated from this articular surface by a weak interval. The base of the neural arch is wide. The length being equal to 100, the height is 175, the width 168.

An anterior dorsal vertebra similarly has a length of 0.034 m, height 0.055 m, and width 0.037 m (length 100; height 161; width 167). The greatest width of the articular surface is reported toward the top. On the ventral surface is a sharp carina, on each side of which are vascular foramina. The attachment surface for the neurapophysis is wide and descends low on the lateral surfaces; the part of this attachment seen on the dorsal surface is wide and very deep.

PLESIOSAURUS LATISPINUS Owen.

This species, described by Mr. Owen[1], differs from *P. pachyomus* by the great length and width of the centrum relative to the height, the smaller and more prominent costal surface, and the thinner edge of the articular surface.

Noted in the glauconitic chalk with *Ammonites inflatus* (*Upper Greensand*) of Cambridge, besides in the lower Gault (*Lower Greensand*) of the Isle of Wight, *Plesiosaurus latispinus* was found by Mr. Ch. Barrois in the *Ammonites mammillaris* greensands of Grandpré in the Ardennes, and by Mr. L. Pierson in the environs of Bar-le-Duc.

A cervical vertebra coming from this last locality entirely resembles the vertebra figured by Mr. Owen under no. 2 of plate VII, and indicates a species of large size; indeed, the length of the centrum is 0.080 m, the height of the articular surface is 0.078 m, and its width is 0.092 m (length 100; height 98; width 115). The articular surfaces, a little oblong transversely, are hardly excavated and slightly prominent in the middle; the edge is a little thick. The ventral surface, hardly excavated longitudinally, bears a wide but hardly salient carina, on each side of which is seen a rather wide vascular foramen; the surface is slightly concave between this carina and the attachment surface for the rib. Situated at the edge of the ventral and lateral surfaces, it is placed closer to the posterior edge than the anterior; it occupies only half of the length of the centrum; its form is oval. The lateral surfaces are slightly excavated anteroposteriorly. The base of the neural arch is wide.

Another cervical vertebra comes from the *Ammonites mammillaris* beds of Louppy (Meuse), forming part of the collection of the Faculty of Sciences of Lille. This vertebra is 0.067 m long, the articular surfaces being 0.056 m tall with a bi-transverse diameter of 0.068 m (length 100; height 95; width 101). The transversely oval articular

[1] *Descriptive Catalogue of the Fossil Remains of Reptilia and Pisces in the Museum of the Royal College of Surgeons*, p. 63, 1854. — *Monog. of the foss. Rept. of the Cret. Form., Suppl. no. II; Palaeont. Soc.*, 1864; p. 14, Pl. VII, VIII, IX.

surfaces are flat. The ventral surface bears a salient carina on each side of which the surface is slightly excavated up to the print for the rib. This print, situated at nearly an equal distance from the anterior and posterior edges, is oval and occupies nearly the length of the centrum.

PLESIOSAURUS PLANUS, Owen[1].

Plesiosaurus planus, from the *Upper Greensand* of Cambridge, is characterized by flattening of the articular surfaces; the vertebrae are short and indicate a small-sized species; the costal surfaces are straight and oblong; the neural surface is extended toward the posterior part of the centrum; the neurapophyseal surfaces, of the same size anteriorly, are smooth and hardly deep, their contour being saddle-shaped; the flattening of the terminal surfaces is remarkable and indicates weak movements of the neck.

In the mid-dorsal vertebrae the dorsoventral diameter of the centrum increases at the expense of the transverse diameter; the articular surface is weakly concave, with a slight elevation at its middle. In the tail the vertebrae are short and massive; the articular surfaces are more excavated than in the other vertebrae.

P. planus was found in the Cretaceous phosphates of Bar-le-Duc. One vertebrae is 0.040 m long, 0.060 m tall, and 0.077 m wide (length 100; height 150; width 192). This species was also recovered by Mr. Ch. Barrois in the *Am. mammillaris* zone of Grandpré, in the Ardennes.

POLYCOTYLUS SP.

The genus *Polycotylus*, established by Mr. Cope[1], was represented only by one species in the Cretaceous of America, when I made known under the name *Polycotylus suprajurensis*[2] another species established on a humerus recovered in the upper Kimmeridgian beds of Boulogne-sur-Mer.

I believe that a fragment of another humerus found by Mr. Ch. Barrois in the Gault with *Ammonites milletianus* of Grandpré (Ardennes) should be referred to the same genus. The articular head of this bone much resembles that of *Polycotylus suprajurensis*; the glenoid part is entirely smoother and presents a sort of salient crest that divides it in two; the contours of this part are also different. The fragment that I figured in the Bulletins of the Geological Society[3] certainly indicates a species distinct from those of the Cretaceous of America and the Upper Jurassic of Boulogne-sur-Mer; it is desirable that the discovery of better-preserved bones would make more completely known this still poorly defined genus in the Cretaceous of Europe.

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[1] *Monog. of the foss. Rept. of the Cret. Form., Suppl. no. II; Palaeont. Soc.*, 1864; p. 2, Pl. I, II, III.

[1] *Synopsis of the extinct Batrachia and reptiles of North America* (*Transations of the American Philosophical Society*, 2nd series, vol. XIV), p. 34, Pl. I, fig. 1, 12; 1870. — *Verteb. Cret. form. West.*, p. 70, Pl. VII, fig. 7; 1875.

[2] *Notes sur les reptiles fossiles: De la présence du genre* Polycotylus *dans le Jurassique supérieur et la Craie du nord de la France* (*Bull. Soc. Géol. Fr.*, 3rd ser., vol. IV, p. 435; 1876).

[3] *Id.*, Pl. XII, fig. 4.

POLYPTYCHODON INTERRUPTUS Owen
(Pl. II, fig. 9, 10, 11.)

Under the name *Polyptychodon*, Mr. Richard Owen established in 1841[4] a genus for reptiles of uncertain placement, characterized by strongly grooved teeth; this genus was found in the lower beds of the Cretaceous terrain of England. Later, Mr. Owen made known that the teeth were implanted in distinct alveoli, as in crocodiles.[5] Some more recent discoveries, made in the Lower Greensand of Kent county, showed that the skull, pubis, ischium, and vertebrae brought this genus closer to the plesiosaur type; also, although the ends of the limbs are still unknown, Mr. Owen placed it in the order Sauropterygia. Mr. Seeley finally studied the same genus.

Two species are admitted by Mr. Owen according to the teeth, *Polyptychodon continuus* from the *Lower Greensand*, and *Polyptychodon interruptus* from the *Upper Greensand*; this species was found in the Cretaceous of Lewes.

Polyptychodon interruptus was recovered in France by Mr. Charles Barrois in the Gault with *Ammonites mammillaris* of Grandpré and Louppy in the Ardennes, and by Mr. Pierson in the *Ammonites mammillaris* beds of Bar-le-Duc; it was also noted at Boulogne-sur-Mer in the same beds.

The Meuse provided the very well-preserved tooth that I figure. This tooth is 0.125 m long, the enameled part being 0.095 m; the crown is noticeably circular. The external face bears only five or six strong salient ribs, of which three are continued up to the apex; between these ribs the enameled surface is vermiculate. The internal face is ornamented with about fifty strong, numerous striations, of which twenty are extended to the apex of the crown; between these principal striations are others that are elevated in general up to a little more than half the height of the tooth, whereas others are only continued a brief distance. The thickness of the tooth at the base of the enameled portion is 0.040 m, the full part being only 0.004 m thick; indeed, at the base of the tooth exists a wide, cone-shaped pulp cavity, 0.030 m wide; toward the upper third of the tooth, the thickness of which is 0.030 m, the width of the pulp cavity is only 0.006 m; still higher, this width is reduced to 0.005 m; the cavity disappears toward the apex (Pl. II, fig. 9).

The ornamentation of the tooth differs according to the place that it occupies in the jaw; thus I was able to study a tooth that on the external face bears more numerous striations than on the tooth described above. It is the same for two small teeth that were conveyed to me by Mr. Péron.

The tooth figured under no. 10 of plate II is without doubt an anterior tooth; it is recurved toward the internal face, which is thus ornamented as I said; on the external face the striations are stronger and more numerous than on the typical tooth described above. Finally, these striations are quite as numerous on the external face as on the internal face of a tooth (fig. 11) that seems to fall between *Polyptychodon interruptus* and *Polyptychodon continuus*, such that I have strong doubts as to the validity of this latter species, established without doubt on teeth from the anterior part of the jaws.

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[4] *Report on British Fossil Reptiles* (*Trans. Brit. Ass.*, 1841, p. 156).

[5] *Report of the British Association*, 1859, p. 153. — *Monograph on the fossil Reptilia of the Cretaceous Formations; Palaeont. Soc.*, 1851. — Cf. Dixon: *Geol. and Fossils of the Tertiary and Cretaceous of Sussex*, Pl. XXXVIII, fig. 3.

The teeth figured were recovered by Mr. Péron in the *Am. mammillaris* zone of Grandpré; Mr. Barrois found the species at Villotte (Meuse).

CHAPTER III

ON THE HERPETOLOGICAL FAUNA DURING THE GAULT EPOCH.

In the preceding pages, it was seen that several reptile species were common to the Aptian and Albian on the one hand, and to the Albian and the *Ammonites inflatus* bed at the base of the Cenomanian on the other; also, not to divide the study of the reptiles found in the lower part of the Cretaceous terrains of the eastern Paris Basin, I believed that I could include the Aptian and Albian terrains under the name Gault, from the example of several German geologists and that of Mr. Barrois himself. Although belonging to the base of the Cenomanian terrain according to the new studies of Mr. Barrois, the fauna of the *Ammonites inflatus* zone is still so close to that of the Albian terrain, that I believe there can be no serious disadvantage in joining this zone together with the Albian, and designating here under the name Gault all the beds included between the *Ostrea aquila* and *Ammonites mammillaris* zone, corresponding to the *Pebble Beds* and *Lower Greensand* above the *Pebble Beds* of England, and the *Ammonites inflatus* zone, to which Mr. Barrois has assimilated part of the *Upper Greensand* of Cambridge. Moreover, this reunion has the advantage of permitting me to compare the herpetological fauna of the Gault of the Ardennes and Meuse with the fauna of the *Lower Greensand* and *Upper Greensand* of England. With Mr. Charles Barrois, I will say first that the *Ammonites mammillaris* zone, rich in reptiles in the northeast of the Paris Basin, has its equivalent in England in the *Folkestone Beds*, the upper part of the *Lower Greensand*; the base with *Ammonites interruptus* corresponds exactly to W. Smith's Gault of Cambridgeshire and Mr. Price's lower Gault of Folkestone; the chalk bed with phosphate nodules of Talmats (Ardennes) and Montblainville (Meuse) that forms part of the *Epiaster ricordeanus* zone corresponds to that of Cambridge; regarding the *Ammonites interruptus* zone, it can be assimilated with the upper part of the *Upper Greensand* of the Isle of Wight, Dorsetshire, Cambridgeshire, the Wealden region, and the upper Gault of Folkestone[1].

In understanding the Gault as I have come to do so, it will be seen that its herpetological fauna is very rich, as the following list of species, nearly all from the *Upper Greensand* of Cambridge, proves[1]:

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[1] Cf. Ch. Barrois, *Sur le Gault et sur les couches entre lesquelles il est compris dans le bassin de Paris* (*Ann. Soc. géol. du Nord*, vol. II, 1874). — *Mémoire sur le terrain crétacé des Ardennes et des régions voisines* (*Ann. Soc. géol. du Nord*, 1878).

[1] For the reptiles of the Gault see: Mantell, *A memoir on the fossil Reptilia of the south east of England*. — Dixon, *Geol. and foss. of the Tertiary and Cretaceous Formations of Sussex*. — Carter, *London Geological Journal*, vol. I. — R. Owen, *Brit. foss. rept. (Trans. Brit. Ass.*, 1841); *Report on the Brit. Ass.*, 1859; *Descriptive Catalogue of the Fossil Remains of Reptilia and Pisces in the Museum of the Royal College of Surgeons*, 1854; *Monog. foss. rept. Cret. form. (Pal. Soc.*, 1851, 1859, 1860, 1864); — Ch. Barrois, *Les reptiles du terrain crétacé du nord-est du bassin de Paris (Bull. sc. et litt. du Nord*, vol. XI, 1875). — H. E. Sauvage, *De la présence du type Dinosaurien dans le Gault du nord de la France (Bull. Soc. Géol. Fr.*, 3rd ser., vol. IV, 1876); *De la présence du genre* Polycotylus *dans le Jurassique supérieur et la Craie du nord de la France* (*Id.*, vol. IV, 1876). — H. G. Seeley, *Index to fossil remains of Aves, Ornithosauria and Reptiles*, 1869; *On* Cetarthrosaurus walteri, *an Ichthyosauria from the Cambridge Upper Greensand* (*Q. J. G. S.*, vol. XXIX, 1873); *On cervical and dorsal vertebrae of* Crocodilus cantabridgensis, *from the Cambridge Upper Greensand (Id.*, vol. XXX, 1874); *On the base of a large Lacertilian cranium from the*

ORNITHOSAURIA.

Ornithocheirus carteri Seeley.
" *platyrhinus* Seeley.
" *simus* Owen.
Coloborhynchus clavirostris Owen.
" *sedgwicki* Owen.
Pterodactylus woodwardi Owen.
" *daviesi* Owen.
" *fittoni* Owen.
" *cuvieri* Bow.
" *owenii* Seeley.
" *platyodon* Seeley.
" *microdon* Seeley.
" *scaphorhynchus* Seeley.
" *brachyrhinus* Seeley.
" *dentatus* Seeley.
" *crassidens* Seeley.
" *nasutus* Seeley.
" *tenuirostris* Seeley.
Pterodactylus capito Seeley.
" *macrohinus* Seeley.
" *eurygnathus* Seeley.
" *machaerhynchus* Seeley.
enchorhynchus Seeley.
" *colorhinus* Seeley.
" *oxyrhinus* Seeley.
" *platystomus* Seeley.

LACERTILIA.

CHELONIA.

Rhinochelys pulchriceps Owen.
" *mastocephalus* Seeley.
" *eurycephalus* Seeley.
" *stenicephalus* Seeley.
" *cardiocephalus* Seeley.
" *dayi* Seeley.
" *platyrhinus* Seeley.
" *rheporhinus* Seeley.
" *graptocephalus* Seeley.
" *dacognathus* Seeley.
" *colognathus* Seeley.
" *sphenicephalus* Seeley.
" *dimerognathus* Seeley.
" *grypus* Seeley.
" *platycephalus* Seeley.
" *leptognathus* Seeley.
Protemys serrata Owen.
Platemys lata Owen.
Emys sphenognathus Seeley.
Trachydermochelys phlyctaenus Seeley.
Testudo cantabrigiensis Seeley.

ICHTHYOSAURIA.

Ichthyosaurus campylodon Owen.
" *dongtyi* Seeley.
" *bonneyi* Seeley.
" *platymerus* Seeley.

Potton sand, presumably Dinosaurian (Id., vol. XXX, 1874); *On the associated series of cervical and dorsal vertebrae of* Polyptychodon (*Id.*, vol. XXXII, 1876); *On* Crocodilus icenicus, *a second and large species of Crocodile from the Cambridge Upper Greensand* (*Id.*, vol. XXXII, 1876); *On* Macrurosaurus semnus, *a long tailed animal with procoelous vertebrae from the Cambridge Upper Greensand* (*Id.*, vol. XXXII, 1876); *On* Mauisaurus gardneri, *an Elamosaurian from the base of the Gault at Folkestone* (*Id.*, vol. XXXIII, 1879); *On the axial skeleton of* Eucercosaurus tanyspondylus, *a Dinosaur from the Cambridge Greensand* (*Id.*, vol. XXXV, 1879); *On the Dinosauria of the Cambridge Greensand* (*Id.*, vol. XXXV, 1879); *Note of an axis of a Dinosaur from the Cambridge Greensand, preserved in the Woodwardian Museum of the University of Cambridge* (*Id.*, p. 594); *On the vertebral characters of* Acanthopholis horridus *from the base of the chalk marl near Folkestone* (*Id.*, p. 596); *On the skeleton of* Anoplosaurus curtonotus, *Seeley, a Dinosaur from the Cambridge Greensand* (*Id.*, p. 600); *On the axial skeleton of* Eucercosaurus tanyspondylus, *a Dinosaur from the Cambridge Greensand* (*Id.*, p. 621); *On the dorsal and caudal vertebrae of* Acanthopholis stereocercus, *Seeley, a Dinosaur from the Cambridge Greensand, with some notice of a second species of* Anoplosaurus *collected with these remains* (*Id.*, p. 628); *On a series of caudal vertebrae of a Dinosaur from the Cambridge Greensand (Id.*, p. 632). — H. E. Sauvage: *Sur les reptiles trouvés dans le Gault de l'est de la France (Comp. Rend. Ac. Sc.*, vol. XCIV, p. 1265, 1st May 1882.

Cetarthrosaurus walkeri Seeley.

Raphiosaurus sp. Owen.
Dacosaurus sp. Sauvage.

DINOSAURIA.

Macrurosaurus semnus Seeley.
Acanthopholis platypus Seeley.
" *stereocercus* Seeley.
" *eucercus* Seeley.
Anoplosaurus major Seeley.
" *curtonotus* Seeley.
Syngonosaurus macrocercus Seeley.
Eucercosaurus tanyspondylus Seeley.
Megalosaurus superbus Sauvage.
Hylaeosaurus sp.?
Iguanodon? (*fid.* Owen).
Hadrosaurus? (*fid.* Owen).

CROCODILIA.

Crocodilus icenicus Seeley.
" *cantabrigiensis* Seeley.
Crocodilian indet.

PLESIOSAURIA.

Plesiosaurus bernardi Owen.
" *ichthyospondylus* Seeley.
" *latispinus* Owen.
" *planus* Owen.
" *cynodeirus* Seeley.
" *microdeirus* Seeley.
" *poltydeirus* Seeley.
" *eurispondylus* Seeley.
" *pachyomus* Owen.
" *neocomiensis* Campiche.
" *ophiodeirus* Seeley.
" *constrictus* Owen.
" *paecilospondylus* Seeley.
Mauisaurus gardneri Seeley.
Stereosaurus platyomus Seeley.
" *cratynotus* Seeley.
" *steneomus* Seeley.
Polyptychodon interruptus Owen.
Polycotylus sp. Sauvage.

With these reptiles, Mr. Seeley noted two birds in Cambridge, *Enaliornis barrati* Seeley and *Enaliornis sedgwicki* Seeley.[1]

What is striking first of all when studying this fauna is the predominance of animals of the group *Ornithosauria*, nearly all in the *Upper Greensand* of Cambridge; indeed, the pterodactyls form more than one-third of the number of reptiles known at this level and more than one-quarter of the total number of reptiles known at present from the *Ammonites milletianus* beds up to the *Ammonites inflatus* beds.

It was possible to think first of all that this abundance of pterodactyls is based on species established on incomplete remains, for the most part made to do doubly duty. However this is not the case, and Mr. Seeley took care to note that, with two exceptions, he knew these species based on the study of the upper jaw.

The pterodactyls, numbering 26 species, are distributed between the genera *Ornithocheirus, Coloborhynchus*, and *Pterodactylus*.

Mr. R. Owen shows that in the pterodactyls, sometimes the symphysis is extended in a long process lacking teeth, as is the case in Hermann de Meyer's genus *Rhamphorhynchus*, a genus belonging to his group of tenuirostrans, and sometimes, in contrast, the rostrum is short and obtuse, as is seen in the species that form part of the subulirostran group. It is in this last group that the genus *Coloborhynchus* belongs, in

[1] *On the British fossil Cretaceous birds* (*Q. J. G. S.*, vol. XXXII, p. 496, Pl. XXVI, XXVII, 1876. — *Index*).

which the median pair of teeth in the upper jaw is longer than the others[1]. The genus *Ornithocheirus*, established by Mr. Seeley[2], is distinguished by the anterior part of the palate which is lacking teeth. The species known of the genus *Pterodactylus* have not yet been described by Mr. Seeley, so that I cannot judge their affinities.

The turtles are as widely represented as the pterodactyls; indeed, at Cambridge I know of 21 species distributed among 6 genera. One of these species, *Testudo cantabrigiensis* Seeley, is part of a still-living and essentially terrestrial genus. *Trachydermochelys*, close to *Holochelys* Hermann de Meyer, has affinities with recent *Chelys*; *Platemys* and *Protemys*, with *Emys*, these last noted remains at Cambridge (*Emys sphenognatus* Seeley).

All the other turtles, numbering 16 species at Cambridge, form part of the genus *Rhinochelys*, of which *Chelone pulchriceps* Owen is the type. This genus is well characterized by the distinct nasal and prefrontal bones, the posterior nares formed by the maxillary and palatine bones, the vomer extended to the palate between the palatines and premaxillae, and the temporal region covered by a bony vault. In living nature this character is general in all the species of the genera *Dermochelys*, *Thalassochelys*, and *Chelone*, genera belonging to the two tribes *Chelonina* and *Sphargidina* of the family *Chelonida*; it is met exceptionally in other groups; it is also noted in *Peltocephalus*, *Podocnemys*, and *Demerilia* of the tribe *Chelydina*, and in *Platysternon* of the tribe *Chersemydina*, that is in the two tribes that compose the family *Testudinina*[3]. According to Mr. Seeley, the genus *Rhinochelys* belongs to an intermediate group between *Chersemydina* and *Chelonina*.

It is advisable to place the crocodilians, known at Cambridge by two species and in the Meuse by a still very poorly defined type, near the turtles.

Studying the ancient crocodiles, Mr. Huxley understood three stages in the evolution of these reptiles.[4]

The pre-Jurassic crocodiles, such as *Stagonolepis* and *Belodon* from Germany and North America, *Parasuchus* from India, and *Pristodon* from southern Africa, have a straight, elongated skull and imperfect cuirasses; the vertebrae are amphicoelous, as in crocodilians from the Mesozoic era. In the Triassic *Parasuchia*, the palatines and pterygoids are not extended into bony plates to contribute to the formation of a posterior opening of the nasal fossa, from which it results that the nasal cavity communicates with the mouth by an opening situated at the anterior part of the skull; the opening of the Eustachian tube is not delimited by bones.

In contrast, in the *Mesosuchia* the palatines are extended so that the posterior opening of the nasal fossa opens near the mid-length of the skull between the basioccipital and basisphenoid; the lateral Eustachian canals are lodged in a simple furrow. The *Mesosuchia* lived from the Liassic (*Steneosaurus* [*Mystriosaurus*], *Pelagosaurus*) up to the base of the Cretaceous (*Goniopholis, Pholidosaurus, Macrorhynchus*); they are numerous during the Jurassic period (*Steneosaurus, Teleidosaurus, Teleosaurus, Machimosaurus, Metriorhynchus*).

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[1] *Monog. on the fossil Reptilia of the Mesozoic formations, vol. I, Pterodactylia; Pal. Soc.*, 1874.
[2] *Index*, p. XVI.
[3] Cf. L. Vaillant: *Remarques sur la classification et les affinités réciproques des Chéloniens (Bull. Soc. Philom. Paris*, 7th ser., vol. I).
[4] *On* Stagonolepis robertsoni, *and on the evolution of the Crocodilia* (*Q. J. G. S.*, vol. XXXI, p. 423, 1875).

There exist more differences between the *Parasuchia* and *Mesosuchia* than between the *Mesosuchia* and *Eusuchia*; as Messrs. Eudes and Eugène Deslongchamps[1] demonstrated, in the metriorhynchs are found indeed an intermediate position of the posterior naris between what is seen in reptiles belonging to these two suborders. It results that the *Parasuchia*, which up to now are only known in the Triassic, form a very distinct group, whereas the *Mesosuchia* can be regarded as continued by the *Eusuchia* which appear as of the Gault epoch and in the Greensand of New Jersey.[2] *Thoracosaurus* and *Holops* (*Gavialis*?) belong to this suborder, characterized by the palatines and pterygoids extended into bony plates protecting posteriorly the nares that open at the posterior part of the skull; the lateral Eustachian canals are encircled in bone; the median Eustachian opening is composed entirely of the basioccipital and basisphenoid; the vertebrae are procoelous, as in recent crocodiles.

It is remarkable that amphicoelous crocodilians, *Hyposaurus*[3], are found in the Cretaceous of the United States.

Although the crocodilians of Cambridge have all the characters of recent crocodiles, they resemble this American genus by the anterior inclination of the centrum in the cervical vertebrae and the depression of the neural arch in the dorsal vertebrae.

Mr. Cope having regarded a number of cervical vertebrae, along with the composition of the braincase, mandible, pectoral and pelvic girdles in the Cretaceous reptiles known under the name *Liodon*, a mosasaur, has reunited the genera among which these reptiles belong into a distinct order under the name *Pythonomorpha*[4]. Mr. Cope gave the opinion that these animals offered more affinities with ophidians than with any other order of living reptiles.

For Mr. Owen, by the double occipital condyle, the perforated parietal, the presence of Cuvier's columella, the composition of the tympanic and mandible, the structure and mode of attachment of the teeth, the pythonomorphs are *lacertilians*, and in this order by all the characters, except a single which is *iguanian*, they are closer to the *monitors*; but by the dentition, the mode of attachment of the pterygoids, the complete ossification of the palatine vault, the great number of vertebrae lacking zygapophyses, the fusion of the haemal arch with the centrum in several caudal vertebrae, they form a truly distinct mosasaurian group within the order *Lacertilia*.

The lacertilian order in the reptile class perhaps regarded as taxonomically equivalent to the order of carnivores in the class of mammals. However, in this carnivore order, it is a group that forms a well-defined suborder, by the modifications of the skull, dentition, vertebral column, and above all the limbs: this is the *Pinnipedia* or *Phocidae*. Mr. Owen estimates that the mosasaurids correspond among the lacertilians to the phocids among the carnivores.[1]

Although it is so, the pythonomorphs are very rare in the Gault and I can only cite some teeth recovered in the Meuse. These teeth resemble those of dacosaurs or liodons; however I established that these two genera are very close, although distinct, and that the

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[1] E. E. Deslongchamps, *Notes paléontologiques; Prodrome des Téleosauriens du Calvados*.

[2] Cf. Leidy, *Cretaceous reptiles of the United States* (*Smith. Cont*. XIV, 1865). — Cope, *Synopsis of extinct batrachians and reptiles* (*Trans. Amer. Phil. Soc.*, 1869).

[3] Cf. Ed. Cope, *The Vertebrata of the Cretaceous formations of the West* (*Rept. Geol. Surv.*, vol. II).

[4] *Proceed. Boston Society of Nat. Hist.*, 1869, p. 250.

[1] *On the rank and affinities of the reptilian class of the Mosasauridae* (*Q. J. G. S.*, vol. XXXIII, p. 682, 1877).

genus *Dacosaurus* must be placed among the mosasaurs[2] and not among the crocodilians, as Mr. R. Owen believed,[3] still less be regarded as synonymous with the genus *Steneosaurus*, which is a teleosaurian. Mr. Hulke, studying a large jaw from the Kimmeridgian terrains of England, indeed referred it to *Steneosaurus rostro-minor* of Geoffroy Saint-Hilaire, or Cuvier's *second gavial from Honfleur*, wrongly assimilating this species to Quenstedt's *Dacosaurus maximus*.[4]

In a recent work on dinosaurs, which he regarded as a subclass of the reptile class, Mr. O. C. Marsh[5*] divided the dinosaurs into six orders, the *Sauropoda*, *Stegosauria*, *Ornithopoda*, *Theropoda*, *Coeluria*, *Compsognatha*; the order *Hallopoda*, formed for the genus *Hallopus*, is doubtful.

Although composed above all by the Jurassic dinosaurs, Mr. Marsh's classification is too important for me not to analyze it here at least briefly.

The order *Sauropoda* is characterized by hoofed plantigrade feet, five digits on each limb, and the second row of carpal and tarsal bones unossified. The pubes are connected by cartilage; there is no postpubis. The precaudal vertebrae are hollowed. The fore- and hind limbs are appreciably of the same length. The premaxillae lack teeth. Two families belong to this order, *Atlantosauridae*, in which the ischia are directed ventrally (*Atlantosaurus*, *Apatosaurus*, *Brontosaurus*, *Diplodocus*, ?*Camarasaurus (Amphicoelias)*, ?*Dystrophaeus*), and *Morosauridae*, which have the ischia inclined posteriorly (*Morosaurus*). The European representatives of this order are: *Bothriospondylus*, *Cetiosaurus*, *Chondrosteosaurus*, *Eucamerotus*, *Ornithopsis*, and *Pelorosaurus*. All these reptiles are herbivores and have the limbs of lizards.

In the *Stegosauria*, also herbivores, plantigrade and hoofed, there exist five digits on the pes and manus; the pubes are not connected on the midline; the postpubes are present. The forelimbs are very short, the vertebrae solid. There is dermal armor. This order is composed of the families *Stegosauridae (Stegosaurus (Hypsirhophus); Diracodon* with the European genus *Omosaurus*) and *Scelidosauridae*, created for the European genera *Scelidosaurus*, *Acanthopholis*, *Crataeomus*, *Hylaeosaurus*, and *Polacanthus*.

The *Ornithopoda* resemble birds in the composition of their limbs; they are herbivores and digitigrade. They have five digits on the forelimb and three on the hind limb. The pubes are not reunited anteriorly; the postpubes exist. The vertebrae are solid. The forelimbs are reduced. The anterior part of the premaxillae lacks teeth. In the family *Camptonotidae*, which includes the American genera *Camptonotus*, *Laosaurus*, *Nanosaurus*, and the European genus *Hypsilophodon*, the clavicles are lacking and the postpubes are complete, whereas in the entirely European *Iguanodontidae* (*Iguanodon*,

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[2] H. E. Sauvage, *Notes sur les reptiles fossiles; sur le genre* Dacosaurus (*Bull. Soc. géol. Fr.*, 3rd ser., vol. I, p. 380, 1873).

[3] *Palaeontology*, 2nd ed., p. 300.

[4] *Note on some fossil remains of a gavial-like saurian from Kimmeridge Bay…establishing its identity from Cuvier's "deuxième Gavial d'Honfleur", "Tête à museau plus cort"* (Steneosaurus rostro-minor *of Geoffroy Saint-Hilaire, 1828), and with Quenstedt's* Dacosaurus (*Q. J. G. S.*, 1869, p. 390).

[5] *Classification of the Dinosauria* (*American Journal of Science*, vol. XXI, 1882). — *Notice of new Jurassic reptiles* (*Id.*, vol. XVIII, 1879). — *A new order of extinct Jurassic reptiles* (*Id.*, vol. XXI, 1881). — *Principal characters of American Jurassic dinosaurs* (*Id.*, vol. XVII, 1878; vol. XVIII, 1879; vol. XIX, 1889; vol. XXI, 1881). — *The sternum in dinosaurian reptiles* (*Id.*, vol. XIX, 1880).

[*] Written as "Marsch" throughout [MTC].

Vectisaurus), the clavicles exist and the postpubes are incomplete. The teeth form several rows in the *Madrosauridae*,* which has opisthocoleous anterior vertebrae (*Madrosaurus*,* *Cionodon*, ?*Agathaumas*).

The carnivorous *Theropoda* are digitigrade and have grasping claws. The pubes are directed ventrally and ossified on their median contact. The vertebrae are more or less cavernous. The forelimbs are very short. The premaxillae are garnished with teeth. In the *Megalosauridae*, the vertebrae are biconcave, the pubes slender; the astragalus bears a dorsally directed process; there are five digits on the manus and four on the pes (*Megalosaurus, Allosaurus, Coelosaurus, Creosaurus, Dryptosaurus* (*Laelaps*)). The *Zanclodontidae*, which includes only the genera *Zanclodon* and ?*Teratosaurus*, has biconcave vertebrae, wide pubes reunited laterally, astragali without an ascending process, and five digits on each limb; they are yet known only from Europe. The American genera *Amphisaurus (Megadactylus)*, ?*Bathygnathus*, ?*Clepsysaurus*, and the European genera *Palaeosaurus* and *Thecodontosaurus* form the family *Amphisauridae* in which the vertebrae are biconcave, and the pubes are baguette-shaped; there are five digits on the forelimbs and three on the hind limbs. A single genus, *Labrosaurus*, forms the family *Labrosauridae*, characterized by opisthocoelous, cavernous anterior vertebrae, very elongate metatarsals, and slender pubes that are reunited at their anterior ends.

The *Coeluria* have hollowed caudal vertebrae. In the family *Coeluridae* (*Coelurus*), the anterior cervical vertebrae are opisthocoelous, the others biconcave; the metatarsals are very long and slender.

According to Mr. Huxley,[1] the *Compsognatha* forms a group of the same rank as the *Dinosauria* within the subclass *Ornithoscelida*. In the order *Compsognatha* Mr. Marsh admitted the single family *Compsognathidae*, characterized by opisthocoelous anterior vertebrae, three digits on each limb, and ischia bearing a long symphysis on the median part (*Compsognathus*).

Putting aside the *Sauroscelida*, Mr. Huxley divided the dinosaurs into three large groups, the *Megalosauridae*, *Iguanodontidae*, and *Scelidosauridae*.

These latter are clearly separated from the other two groups, which lack dermal armor in the form of escutcheons, plates, and spines. The same arrangement would be found in Cope's *Theromorpha*, if *Euchirosaurus* and *Steroerachis* studied by Mr. Gaudry truly belong to this order;. indeed, Mr. Gaudry noted that in these Permian reptiles from Autun the ribs were wide, the endosternum and episterna very strong, and the belly protected by spine-shaped scales.[2]

Although it is so, the development of dinosaurian reptiles of the group *Scelidosaurida* must be noted in the Gault epoch. The Liassic *Scelidosaurus* was known when Mr. Huxley described *Acanthopholis* from beds at Folkestone that are placed immediately below the Greensand; this genus is represented by three species at Cambridge. *Anoplosaurus* and *Syngonosaurus* are of the same group. The family Megalosauridae certainly exists in the Gault of France with the genus *Megalosaurus*.

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* *sic* = *Hadrosauridae* [MTC].

* *sic* = *Hadrosaurus* [MTC].

[1] Cf. *On the classification of the Dinosauria, with observation of the Dinosauria of the Trias* (*Q. J. G. S.*, vol. XXVI, p. 32, 1870).

[2] Cf. A. Gaudry, *Sur les reptiles de temps primaires* (*Compt. Rend. Ac. Sc.*, 16 Dec. 1876). — *Les reptiles de l'époque Permienne aux environs d'Autun* (*Bull. Soc. géol. Fr.*, 3rd ser., vol. VII, p. 62; 1879). — *Sur les plus anciens reptiles trouvés en France* (*Compt. Rend. Ac. Sc.*, 16 May 1881).

Regarding *Hylaeosaurus* of the family Scelidosauridae, *Iguanodon* of the family Iguanodontidae, and *Hadrosaurus* of the family Hadrosauridae, according to Mr. Seeley they are doubtful in the Gault; besides it must be noted with Mr. Marsh that the family Hadrosauridae seems to be known only in the Cretaceous period.

The place of the genera *Eucercosaurus* and *Macrurosaurus* from the Cambridge beds is difficult to assign; in this last genus the centrum is elongated; chevrons do not exist; the initially procoelous articulation of the caudal vertebrae is modified gradually so that the faces become nearly flat, then biconcave; no reptiles are yet known with procoelous caudal vertebrae lacking chevron bones. The genus *Macrurosaurus* presents some lacertilian characters so that its place among the dinosaurs is doubtful. Mr. Seeley described under the name *Acanthopholis platypus*[1] the metatarsal of a large reptile that could be the macrurosaur, indicating then a type under certain relationships intermediate between crocodilians and dinosaurs. *Eucercosaurus* is characterized by hexagonal, compressed, and elongated caudal vertebrae.

Regarding the macrurosaur, according the Mr. Seeley all the dinosaurs of Cambridge are small animals varying between the size of a sheep and that of a cow; dinosaurs abound at this level; of 500 reptile bones recovered at Cambridge, Mr. Seeley notes no fewer than 376 dinosaur remains.

The little that is known of the osteology of ichthyosaurs makes me think that they must be spread into several groups. Indeed, Mr. H. G. Seeley showed that the disposition of the pectoral girdle varied according to the species, which explains the different interpretations given by Home, Hawkins, Cuvier, de la Bêche, Buckland, Huxley, and Owen. Nearly all ichthyosaurs have reunited clavicles, as in the great majority of birds; such are the animals studied by Cuvier, Home , Hawkins, Owen, and Huxley. In some others, the clavicles do not touch, but connect to the ends of the cruciform process of the episternum by a cartilage (de la Bêche, Buckland). Still others have the clavicles connected by a cartilage that is extended on each bone. Finally in a fourth modification, which according to Mr. Seeley formed the type of the genus *Ophthalmosaurus*, the clavicles are reunited by an interclavicle solidly connected to both bones by a very tight suture.[2]

These genera are not the only ones, and Mr. Marsh made known under the name *Sauranodon* an ichthyosaur from the Jurassic terrains of America characterized by diverse modifications in the composition of the fin;[3] Mr. Seeley designated under the name *Cetarthrosaurus* one of the ichthyosaurs from the Cambridge Greensand in which are found some remains of the genus *Ichthyosaurus* proper.

The works of Mr. Seeley led him to admit that the *Ornithosauria* must form a class partly intermediate between those of birds and true reptiles; similarly the researches of Mr. Gegenbaur made him separate the *Ichthyosauria* and *Plesiosauria*; that is the enaliosaurians, to form a class intermediate between those of reptiles and fishes.

Although it is so, the *Plesiosauria* can be divided into several very distinct types. Without speaking of the Triassic Plesiosauria or simosaurians, I say that a separated interclavicle sometimes exists in plesiosaurs proper (*Plesiosaurus*, *Pliosaurus*,

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[1] *Ann. Nat. Hist.*, Nov. 1871.

[2] Cf. H. G. Seeley, *On the pectoral arch and forelimb of* Ophthalmosaurus, *a new ichthyosaurian genus from the Oxford Clay* (*Q. J. G. S.*, vol. XXXI, p. 694; 1874).

[3] *The limbs of* Sauranodon, *with notice of a new species* (*American Journal of Science*, vol. XIX, 1880).

Polyptychodon), whereas the mesosternal bone does not exist in elasmosaurians (*Elasmosaurus, Colymbosaurus, Polycotylus, Mauisaurus, Muraenosaurus, Cimaliosaurus, Erethmosaurus*, etc.). The composition of the pectoral girdle permits establishing a certain number of cuts in these two families; it is thus that Mr. Seeley[1] grouped into five genera the animals from the Jurassic formations of England that are confounded under the name *Plesiosaurus*, an abstraction made from *Pliosaurus* and *Polyptychodon*, previously separated by Mr. Owen. One genus *Stereosaurus* was created by Mr. Seeley for two plesiosaurs from Cambridge. The genus *Mauisaurus*, found by Mr. Seeley in the Gault of Folkestone, was established by Mr. Hector for a plesiosaur from New Zealand[2]; it is interesting to note a genus common to two regions so distant; a fact bringing this closer is the discovery of two fishes belonging to the chimaera group in the Lower Greensand of New Zealand; one is *Ischyodus brevirostris*m Ag., a species characteristic of the Gault of Folkestone, of the Cambridge beds; the other is *Callorhyncus hectori* Kenton, a species belonging to a still-living genus. The mauisaur is the plesiosaur with the longest neck.

The genus *Polycotylus* established by Mr. Cope[3] forms part of the elasmosaurian family and is characterized by the very reduced neck and relatively strong tail. This genus was only known from one species in the Cretaceous of America, when I noted it in the upper part of the Jurassic terrains of Boulogne-sur-Mer and in the Gault of eastern France.[4]

In the genus *Stereosaurus*, of which three species are known at Cambridge, the limb bones are lacking the trochanter.

The genus *Plesiosaurus* proper is abundantly represented in the beds whose herpetological fauna I am studying. Seven species out of 15 are unique to Cambridge; *P. bernardi* is found from the Neocomian up to the White Chalk, but it is probable that several species are confounded under this name, as Mr. Seeley thinks who has already separated *P. ichthyospondylus* from them. *P. planus* is from the Greensand of Cambridge and Moscow; *P. latispinus* from the Lower Greensand; *P. pachyomus* from the Upper Greensand[5]; *P. neocomiensis*, from the Neocomian of Switzerland and France, is also noted in the beds of Cambridge and Moscow; in this species, which I have been able to make better known, the neck is very elongated.[6]

In the northeastern part of the Austrian Alps is found the celebrated locality of Gosau that Mr. Edouard Suess regards as older than the true Turonian and in particular than the *Hipparites cornu-vaccinum* zone[1]. This freshwater deposit with *Unio, Dejanira*, *Melania* and terrestrial plants, *Banksia,* and *Pecopteris zippei*, is close to the age of the

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[1] *Note on some of the generic modifications of the plesiosaurian pectoral arch* (*Q. J. G. S.*, vol. XXX, p. 436; 1874).

[2] *Trans. New Zeal. Inst.*, vol. VI, 1874.

[3] *Synopsis of the extinct Batrachia and Reptilia of North America* (*Trans. Amer. Phil. Soc.*, 2nd ser., vol. XIV, p. 34, Pl. I, fig. 1-12; 1870).

[4] *De la présence du genre* Polycotylus *dans le Jurassique supérieur et la Craie du nord de la France* (*Bull. Soc. géol. Fr.*, 4th ser., vol. IV, p. 435, Pl. XI, fig. 1, Pl. XII, fig. 4; 1875).

[5] Whidbone, *On the geographical distribution of the genus* Plesiosaurus (*Q. J. G. S.*, vol. XXXVII; 1881).

[6] H. E. Sauvage, *Étude sur les poissons et les reptiles des terrains crétacés et jurassiques supérieurs de l'Yonne* (*Bull. Soc. Sc. Nat. Yonne*, 3rd ser., vol. I, p. 66, Pl. XI, Pl. VII, fig. 4-8).

[1] E. Suess, *Note on the Gosau beds of the Neuen Welt, west of Weiner Neustadt* (*Q. J. G. S.*, vol. XXXVII, p. 702, 1881).

Upper Greensand, and therefore I am interested in speaking about its herpetological fauna.

This fauna was initially studied in 1871 by Mr. Emmanuel Bunzel[2], who noted *Crocodilus carcharidens*, *Iguanodon suessii*, *Struthiosaurus austriacus*, and *Danubiosaurus anceps*; some bones are referred to the genera *Hylaeosaurus*, *Scelidosaurus*, and *Lacerta*, named *Crocodili ambigui*, or are undetermined. The new genus *Struthiosaurus* is placed among the dinosaurs, the genus *Danubiosaurus* among the lacertilians.

Very lately Mr. H. G. Seeley reprised the study of the herpetological fauna of Gosau[3], and it is according to the memoir published by this wise paleontologist that I make briefly known the character of this fauna that interests me, and as I have just said, if it is not contemporaneous with the herpetological fauna of the Gault, it is at least the direct continuation.

The turtles are represented by *Emys neumayri* Seeley, *Pleuropeltus suessii* Seeley, and three other species very incompletely known and not named. The order *Lacertilia* is only known by *Araeosaurus grandis* Seeley, a genus founded on the examination of a single vertebra figured by Bunzel (Pl. VI, fig. 11), that of *Ornithosauria* only by *Ornithocheirus bunzelii* Seeley, a species also established on one vertebra (Bunzel, Pl. VI, fig. 6, 7).

The crocodilian remains are much less abundant than Mr. Bunzel supposed, and according to Mr. Seeley the majority of them must be referred to dinosaurs. There exists above all at Gosau a true crocodilian, *Crocodilus proavus* Seeley (Bunzel, Pl. I; Pl. VI, fig. 12, 13; Pl. VII, fig. 7, 8), known by a large part of the skeleton. This small crocodilian, the size of *Crocodilus cantabrigiensis* Seeley from the Cambridge *Upper Greensand*, probably does not belong in the recent crocodile genus; it is entirely difficult to grasp the characters that separate it at present.

The dinosaurs are represented by nine genera including ten species, of which several are very imperfectly known.

Mr. Bunzel described under the name *Iguanodon suessi* a small herbivorous dinosaur that recalls *Iguanodon mantelli* by certain features at least. Certain characteristics, among others the form of the teeth, must make this species be withdrawn from the genus *Iguanodon*; Mr. Seeley regards it as the type of the genus *Mochlodon*. While having crocodilian characters, the scapula more greatly resembles that of dinosaurs and recalls the scapula of pentadactyl dinosaurs that Mr. Marsh designated under the name *Camptonotus*.

True *Hylaeosaurus* and *Scelidosaurus* are not known in the Gosau beds, but are represented there by close genera. The curious group of scelidosaurian dinosaurs, essentially characterized by bony spines or plates that protect the body (*Acanthopholis*, *Scelidosaurus*, *Hylaeosaurus*, *Polacanthus*, *Priodontognathus*, etc.), include three species there, *Hoplitosaurus insignis* Seeley, *Crataeomus pawlowitschii* Seeley, and *Crataeomus lopidophorus* Seeley; *Hoplitosaurus* resembles *Hylaeosaurus*, and *Crataeomus*, *Scelidosaurus*.

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[2] *Die Reptilfauna der Gosauformation in der Neuen Welt bei Weiner Neustadt* (*Abh. d. k. k. grol. Reich.*, vol. V, 1871).

[3] H. E. Seeley, *The reptile fauna of the Gosau Formation preserved in the Geological Museum of the University of Vienna* (*Q. J. G. S.*, vol. XXXVII, p. 620, 1881).

Crataeomus is the best known and the most curious of the reptiles from the Gosau beds; also I will indicate their principal characters, according to Mr. Seeley.

With large scales covering the body, of very different shape depending on the region. The supravertebral scales of the caudal region are compressed and terminate in a trenchant edge like a knife blade; the more or less oval dorsal scales have a less elevated crest; some scales exist without carinae, probably belonging to the ventral region. The scapular region was protected by scales terminating in a sharp-edged spine at each end, whereas the surface is covered by large salient tubercles, resembling those seen in *Hylaeosaurus* and above all in *Polacanthus*. Certain scales, whose place is more difficult to determine, are raised in a strong prolongation recalling the base of an ox horn.

The cervical vertebrae are remarkable for the size of the neural arch, and by the wide space that exists between the anterior and posterior zygapophyses, the brevity of the neural spine, and the biconcave form of the centrum. The dorsals have a wide and rounded base; the caudals resemble similar vertebrae of *Acanthopholis*, but differ from them by a single lateral crest.

It is by the limbs that *Crataeomus* is truly differentiated from related genera. The coracoid is constructed on the same general plan as that of the hylaeosaurs, whereas the scapula, regarded by Mr. Bunzel as the rib of a lacertilian and designated by this paleontologist under the name *Danubiosaurus anceps*, is entirely different from that of other dinosaurs by its recurved form and the great development of the acromion. The remarkably robust humerus recalls by its principal traits that of *Anoplosaurus*. The femur lacks the external trochanter seen at the proximal end in iguanodontians. The fibula recalls remarkably that of birds. The tarsal bones indicate a flattened pes terminated by strong rather than sharp-edged claws; all indicate a carnivorous, robust, quadrupedal animal.

The genus *Struthiosaurus* (*S. austriacus* Bunzel) is founded on the posterior part of the skull of a dinosaur whose affinities are with *Acanthopholis*, and as a result with the scelidosaurians.

Two other carnivorous dinosaurs were found in the Gosau beds; *Megalosaurus pannoniensis* Seeley, a species founded on the study of a single tooth from the anterior part of the jaws that greatly resembles the similar tooth of *Megalosaurus insignis* from the Upper Jurassic[1] and *Oligosaurus adelus* Seeley.

Mr. Bunzel described under the name *Crocodilus carcharidens* various elements coming from the head. Finding some characters in these bones more dinosaurian than crocodilian, Mr. Seeley designated them under the name *Doratodon carcharidens*. The genus *Rhadinosaurus* (*R. alcinus* Seeley) was established for several limb bones that perhaps belong to *Doratodon*.

In summary, the species found in the Gosau formations up to now are the following:

DINOSAURIA: *Mochlodon suessi* Bunzel. *Struthiosaurus austriacus* Bunzel. *Crataeomus pawlowitschii* Seeley. *Crataeomus lepidophorus* Seeley. *Megalosaurus pannoniensis* Seeley. *Ornithomerus gracilis* Seeley. *Doratodon carcharidens* Bunzel. *Rhadinosaurus alcinus* Seeley. *Oligosaurus adelus* Seeley. *Hoplosaurus ischyrus* Seeley.

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[1] Cf. H. E. Sauvage, *Mém sur les Dinosauriens et les Crocodiliens des terrains jurassiques de Boulogne-sur-Mer* (*Mém. Soc. géol. Fr.*, 2nd ser., vol. X, 1874).

CROCODILIA: *Crocodilus proavus* Seeley.
CHELONIA: *Pleuropeltus suessi* Seeley. *Emys neumayri* Seeley.
LACERTILIA: *Araeosaurus gracilis* Seeley.
ORNITHOSAURIA: *Ornithocheirus bunzeli* Seeley.

TABLE OF CONTENTS

FIRST CHAPTER
ON THE REPTILE LOCALITY IN THE GAULT OF THE EASTERN PARIS BASIN

CHAPTER II
STUDY OF THE REPTILES FROM THE GAULT OF THE EASTERN PARIS BASIN

CHAPTER III
ON THE HERPETOLOGICAL FAUNA DURING THE GAULT EPOCH

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EXPLANATION OF PLATE I.

Megalosaurus superbus, Sauvg.

Fig. 1. 1*a*. Femur; 1*b*, distal articular surface. Reduced two-fifths.
Fig. 2. Fibula, distal articular surface. Natural size.
Fig. 3. 3*a*. Metatarsal; 3*b*, proximal articular surface; 3*c*, distal articular surface. Reduced one-half.
Fig. 4. First phalanx of the third digit of the manus; 4*a*, distal articular surface. Natural size.
Fig. 5. Phalanx of the external digit of the manus; 5*a*, distal articular surface; 5*b*, proximal articular surface. Natural size.

EXPLANATION OF PLATE II.

Megalosaurus superbus, Sauvg. — *Hylaeosaurus* sp. — *Pterodactylus sedgwicki*, Ow. — *Dacosaurus. — Polyptychodon interruptus*, Ow. — *Ichthyosaurus campylodon*, Cart.

Fig. 1 to 5. *Megalosaurus superbus.*
Fig. 1. Manus, natural size; 2, second digit; 3, third digit; 4, fourth digit; *mt*, metacarpal; *p, ph, pl*, phalanges; *un*, ungual phalanx.
Fig. 2. Cuboid, natural size; 2*a*, dorsal surface.
Fig. 3. Tooth recovered at Louppy; natural size. Collection of the Faculty of Sciences of Lille.
Fig. 4. Tooth recovered at Louppy; natural size.
Fig. 5. Tooth from the anterior part of the jaws; natural size. Collection of the Faculty of Sciences of Lille.
Fig. 6. Escutcheon of *Hylaeosaurus*? Doubled in size. Collection of the Faculty of Sciences of Lille.
Fig. 7. Cross-section of a tooth of *Pterodactylus sedgwicki*, Ow.
Fig. 8. Cervical vertebra of *Pterodactylus sedgwicki*, Ow. Natural size. Collection of the Faculty of Sciences of Lille.
Fig. 9. *Polyptychodon interruptus*, Ow. Tooth at natural size.
Fig. 10. *Polyptychodon interruptus*, Ow. Tooth at natural size. Collection of the Faculty of Sciences of Lille.
Fig. 11. *Dacosaurus*. Tooth at natural size. Grandpré locality. Collection of Mr. Péron.
Fig. 12. *Ichthyosaurus campylodon*, Cart. Tooth at natural size. Grandpré locality (Ardennes). Collection of the Faculty of Sciences of Lille.

1. All the elements figured without indications of origin were recovered at Penthiève, Louppy-le-Château commune (Meuse), and form part of the collection of Mr. Louis Pierson.

The elements not having been drawn with mirrors have been turned over on the plates.

EXPLANATION OF PLATE III.

Megalosaurus superbus, Sauvg. — Crocodilian indet.

Fig. 1 to 3. *Megalosaurus superbus*.
Fig. 1. Proximal end of the tibia; 1*a*, distal articular surface. Reduced by one-half.
Fig. 2. Metacarpal or external metatarsal; 2*a*, proximal articular end. Reduced by one-half. Grandpré locality (Ardennes). Péron collection.
Fig. 3. Phalanx of a dinosaur referred with doubt to the megalosaur; 3*a*, distal articular surface. Natural size.
Fig. 4. Proximal end of an indeterminate crocodilian femur of large size. Natural size.
Fig. 5. Distal end of a tibia from the same crocodilian; 5*a*, distal articular surface. Natural size.

EXPLANATION OF PLATE IV.

Megalosaurus superbus, Sauvg. — Crocodilian indet. — *Ichthyosaurus campylodon*, Cart.

Fig. 1 to 4. *Megalosaurus superbus*.
Fig. 1. Distal end of the radius; 1*a*, distal articular surface. Reduced by one-half.
Fig. 2. Clavicle. Reduced by one-half.
Fig. 3. Phalanx; 3*a*, proximal articular end; 3*b*, distal articular end. Natural size.
Fig. 4. Phalanx from a young individual. Natural size.
Fig. 5. Dorsal vertebra of an indeterminate crocodilian. Natural size.
Fig. 6. Quadrate of *Ichthyosaurus campylodon*, Cart. Reduced by one-half.
Fig. 7. Humerus of *Ichthyosaurus campylodon*, Cart. Reduced by one-half. *Ammonites mammillaris* zone at Grandpré (Ardennes). Collection of the Faculty of Sciences of Lille.
Fig. 8. *Teredo serpuloides*, Rochbr.
Fig. 9. *Natica lamellifera*, Rochbr.