AN IMMATURE SPECIMEN OF THE CROCODILIAN *BERNISSARTIA* FROM THE LOWER CRETACEOUS OF GALVE (PROVINCE OF TERUEL, SPAIN)

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ABSTRACT. An almost complete skeleton of a small crocodilian has been found in the Barremian–Aptian of Galve (province of Teruel, Spain). Its well preserved skull is described here. Several cranial features are very reminiscent of *Bernissartia fagesii* Dollo, from the Wealden of Belgium: general outline, proportions of the snout and of the posterior region, anterior outline of the orbits, relative proportions of the orbits and supratemporal fenestrae, absence of a maxillary depression. A few features are different in the Spanish and Belgian specimens, such as the relative proportions of snout, orbits, and cranial table. However, these divergences are explainable by the immaturity of the Galve specimen, which we refer to the genus *Bernissartia*.

THE genus *Bernissartia* was described by Dollo (1883) on the basis of crocodilian remains found in the Wealden beds of the famous coal mine at Bernissart (Belgium). Although a complete skeleton was found, anatomical details were poorly preserved: cranial sutures are hardly visible, and the ventral part of the skull is difficult to interpret (Buffetaut 1975). As a result, the systematic position of *Bernissartia* has been much disputed. Dollo (1883) considered it as a representative of a new family of the Mesosuchia (Bernissartidae), different from the Goniopholididae. Lydekker (1888) proposed its inclusion in a subfamily of the Goniopholididae, the Bernissartinae. Kälin (1955) referred *Bernissartia* to the modern suborder Eusuchia, and he has been followed by various authors, notably Steel (1973).

In 1975, one of us (E.B.) revised the original material of *B. fagesii*, and concluded that it still belongs to the mesosuchian level of crocodilian evolution, and that other crocodilians from the Purbeck and Wealden beds of England (notably *Theriosuchus* Owen 1879) are more progressive than *Bernissartia* and may be closer to the ancestry of the Eusuchia. Kälin's interpretation was thus rejected, and Dollo's systematic proposal was accepted. Since then, very incomplete remains of *Bernissartia* (mainly isolated teeth) have been reported from the Wealden of England (Buffetaut and Ford 1979).

We report here the discovery of a complete skeleton of *Bernissartia* in the lower Cretaceous of Spain, and give a preliminary description of its skull to justify its sytematic allocation.

THE CROCODILIANS FROM THE LOWER CRETACEOUS OF GALVE

Various crocodilian remains have already been reported from the lower Cretaceous of Galve (province of Teruel, Spain). Kühne (1966) reported crocodilian teeth and scutes. Crusafont-Pairó and Adrover (1966) and Berg and Crusafont-Pairó (1970) have referred blunt and rounded isolated teeth to the alligatorid *Allognathosuchus* Mook but they more probably belong to *Bernissartia* (Buffetaut and Ford 1979). Estes and Sanchiz (1982) have referred isolated teeth to the families Atoposauridae, Pholidosauridae, and Bernissartidae (cf. *Bernissartia* sp.). The specimen described in the present paper is much more complete than the isolated scutes and teeth hitherto reported from Galve. It is an almost complete skeleton, including the whole skull, which will require further preparation, and may eventually provide a better knowledge of the still problematic genus *Bernissartia*.

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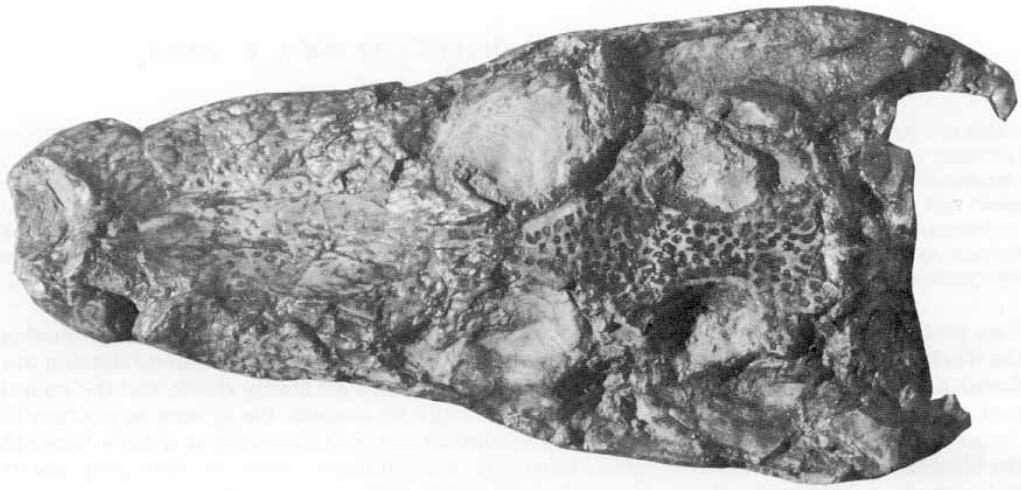
Together with the crocodilians, several types of dinosaurs also occur in the Galve deposits. They include an indeterminate brachiosaurine close to *Brachiosaurus* Riggs (1903) (Sanz 1982), *Iguanodon bernissartensis* van Beneden (1881) (identified by Lapparent 1960), *I.* cf. *mantelli*, and an indeterminate carnosaur (unpublished data). This reptilian fauna seems to be similar to that from the Wealden beds of England and Belgium. The age of the outcrops at Galve has been determined as Barremian–Aptian by means of charophytes (Crusafont-Pairó and Gibert 1976).



TEXT-FIG. 1. Young individual of *Bernissartia* from the lower Cretaceous of Galve (province of Teruel, Spain). Skull in dorsal view.

The *Bernissartia* skeleton was found in a clay pit called 'Cerrada Roya' by Mr. J. M. Herrero, who lives in Galve and kindly gave the specimen to the authors for study. The material is currently housed in the Zoology Department, Universidad Autonóma de Madrid.

DESCRIPTIVE PALAEONTOLOGY

The skeleton, enclosed in a clay matrix, is small, about 300 mm in length. The skull is slightly distorted due to dorsoventral crushing. The bones are thin, which may be linked to the immaturity of the animal (see below). The snout is short. The bones of the dorsal face of the skull are covered with regularly distributed pits of subcircular shape, easily observable in the frontoparietal region. The total length of the skull from the occipital complex to the anterior region of the premaxillae is 70 mm.

The supratemporal fenestrae are shorter than the orbits; they are bordered by a smooth, unsculptured rim. Their shape is ellipsoidal, with the longer axis parallel to the symmetry plane of the skull. The longitudinal axis is 9·5 mm in length; the transversal axis (width) is estimated to be *c.* 8·5 mm. The smallest distance between the supratemporal fenestrae is 5·5 mm. The orbits present a peculiar outline (text-fig. 1), with an anterolateral notch; their posterior part is definitely wider than the anterior one. A smooth rim borders the orbits especially in the medial zone. The orbits represent one quarter of the total skull length. The smallest interorbital distance is 4·6 mm, and it represents

54% of the length of the frontoparietal suture, both measurements being taken along parallel lines. The interorbital region is slightly concave. The longer orbital axis, measured from the anterior notch to the posterior border of the orbit, is 15·5 mm long. The shorter axis, as measured orthogonal to the longer axis, is 10·8 mm long.

The regions of the postorbital bars and of the external nares are damaged in the Galve specimen. The postorbital bars have been displaced by dorsoventral crushing. Despite this, the postorbital bar does not seem to be in a very internal position, but its interpretation is problematical. In the anterior region of the snout, part of the premaxillae is probably missing. This fact makes it difficult to interpret the external nares, which seem to be very large. The anterior point of the nasals may reach the posterior edge of the nares.

The dorsal outline of the skull displays two main constrictions. The first one is sharp and located at the level of the premaxilla–maxilla suture, while the second one, less sharp, is placed lateral to the orbits, at the level of their anterior notches, and affects the maxillae. Posterior to this level, the sides of the skull diverge toward the quadrate condyles. The posterior width of the skull, from quadrate to quadrate, is 36.7 mm. The skull is 25 mm wide at the posterior constriction, and about 18 mm at the premaxilla– maxilla constriction. The skull table is of subquadrangular shape, and not higher than the snout in lateral view.

Some sutures are difficult to trace (text-fig. 1). A sagittal suture separates the nasals and divides the frontal, and probably also parietal. The nasals form an anterior V-shaped apophysis which separates the premaxillae and seems to reach the external nares. The premaxilla–maxilla suture is clear. This suture is directed obliquely and reaches the nasals at their anterior third. The nasofrontal suture is V-shaped, the anterior point of the frontal separates the posterior regions of the nasals at the level of the orbital notches. The relation between the frontal and the parietal is clear, too: the sutural line separates them at the level of the anterior border of the supratemporal fenestrae. The maxillo-jugal suture appears to be located at the level of the middle region of the orbit. Finally, a suture parallel to the mediosagittal plane separates the parietal from squamosal. The supraoccipital seems to enter the cranial table with a slightly curved suture. The quadratojugal does not take part in the cranio-mandibular articulation.

DISCUSSION

There are many features in common to the crocodilian from the lower Cretaceous of Galve and *Bernissartia fagesii* which distinguish them from other Wealden crocodilians:

1. The general outline of the skull in dorsal view, especially the constriction at the level of the premaxilla–maxilla suture, and the relative proportions of the snout and posterior region. These traits differentiate the Spanish crocodilian from other Wealden forms such as the short-snouted *Theriosuchus* Owen 1879 and the long-snouted *Vectisuchus* Buffetaut and Hutt 1980.
2. The presence of a notch in the anterior border of the orbits.
3. The orbits are relatively larger than the supratemporal fenestrae. This character separates the Galve crocodilian from the Goniopholididae of the European Wealden, such as *Goniopholis crassidens* Owen 1842 and *G. simus* Owen 1878.
4. There is neither an antorbital fenestra nor a maxillary depression (as defined by Buffetaut 1982.) The latter feature is characteristic of the Goniopholididae.
5. The interorbital distance is relatively smaller than in the Goniopholididae; even young individuals of the latter family show a relatively wider interorbital space (cf. Joffe 1967, about *Nannosuchus*). The transversal frontal ridge between the orbits, present in the Goniopholididae (whatever their individual age) is absent in both the Galve crocodilian and *B. fagesii*.
6. The Goniopholididae have a frontoparietal suture in a more posterior position than the Galve crocodilian.

All these characters suggest that our specimen is closely related to *B. fagesii*. Nevertheless, there are also some differences:

1. In *B. fagesii*, the length of the orbit is one sixth of the total cranial length, while it is one quarter in the Spanish form.
2. The snout is relatively shorter, and the cranial table is relatively larger in the Galve crocodilian than in *B. fagesii*.

However, these differences probably indicate that the Galve specimen is an immature individual. Immature crocodilians are known to have relatively short snouts and large orbits (Kälin 1955; Joffe 1967; Webb and Messel 1978). This interpretation is in agreement with the small size of the specimen, and other features seem to corrobate this interpretation, e.g. the presence of an axial suture in the frontal, and possibly the parietal region (cf. Langston 1973). It thus seems legitimate to consider the Galve crocodilian as a juvenile specimen of *Bernissartia*. When preparation of the fossil is completed, a study of the whole specimen should indicate whether it belongs to the same species as the Belgian form.

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REFERENCES

BERG, D. E. and CRUSAFONT-PAIRO, M. 1970. Note sur quelques crocodiliens de l'Eocéne prépyrénaïque. *Act. Geol. Hispanica*, **5**, 54–57.

BUFFETAUT, E. 1975. Sur l'anatomie et la position systématique de *Bernissartia fagesii* Dollo, L., 1883, crocodilien du Wealdien de Bernissart, Belgique. *Bull. Inst. r. Sci. Nat. Belg.* **51**, 2, 1–20.

—— 1982. Radiation évolutive, paléoécologie et biogéographie des Crocodiliens mésosuchiens. *Mem. Soc. Géol. France*, N.S., **60** (142), 1–88.

—— and FORD, R. L. E. 1979. The crocodilian *Bernissartia* in the Wealden of the Isle of Wight. *Palaeontology*, **22**, 905–912.

—— and HUTT, S. 1980. *Vectisuchus leptognathus*, n.g.n. sp., a slender-snouted goniopholid crocodilian from the Wealden of the Isle of Wight. *N. Jb. Geol. Paläont. Mh. Stuttgart*, **7**, 385–390.

CRUSAFONT-PAIRÓ, M. and ADROVER R. 1966. El primer Mamifero del Mesozoico español. *Publ. Cátedra Paleontol. Univ. Barcelona*, **13**, 28–33.

—— and GIBERT, J. 1976. Los primeros multituberculados de España. *Act. Geol. Hispanica*. **3**, 57–64.

DOLLO, L. 1883. Première note sur les Crocodiliens de Bernissart. *Mus. r. Hist Nat. Belg.* **2**, 309–338.

ESTES, R. and SANCHIZ, B. 1982. Early Cretaceous lower vertebrates from Galve (Teruel), Spain. *J. Vertebrate Paleont*, **2** (1), 21–39.

KÄLIN, J. 1955. Crocodilia. *In* PIVETEAU, J. (ed.). *Traité de Paléontologie*. 695–784. Masson and Cie, Paris.

KÜHNE, W. G. 1966. Découverte de dents de Mammiferes dans le Wealdien de Galve (province de Teruel, Espagne). *Teruel*. **35**, 159–161.

JOFFE, J. 1967. The 'dwarf' crocodiles of the Purbeck Formation, Dorset: a reappraisal. *Palaeontology*, **10** 629–639.

LANGSTON, W. 1973. The crocodilian skull in historical perspective. *In* GANS, C. and PARSON, T. S. (eds.) *Biology of the Reptilia*, vol. 4, 263–284. Academic Press, London. New York.

LAPPARENT, A. F. 1960. Los dos dinosaurios de Galve. *Teruel*. **24**, 1–21.

LYDEKKER, R. 1888. Catalogue of the fossil Reptilia and Amphibia in the British Museum (Nat. Hist.), vol. 1, British Museum, London.

OWEN, R. 1842. Report on British fossil reptiles. *Report of the British Association for the Advancement of Science, London*, **11** (1841), 60–204.

—— 1878. Monograph on the fossil Reptilia of the Wealden and Purbeck Formations. Supplement n. 8. Crocodilia, London, *Palaeontogr. Soc. Monogr.*

—— 1879 On the association of dwarf crocodiles (*Nannosuchus* and *Theriosuchus pusillus*, e.g.) with the diminutive Mammals of the Purbeck shales. *Quart. J. Geol. Soc. London*. **35**, 148–155.

SANZ, J. L. 1982. A sauropod dinosaur tooth from the Lower Cretaceous of Galve (province of Teruel, Spain). *Geobios*. **15** (6), 943–949.

STEEL, R. 1973. Crocodylia. *In* KUHN, O. (ed.). *Handbuch der Paläoherpetologie*, **16**, 1–116. Gustav Fischer, Stuttgart, Portland, USA.

WEBB, G. and MESSEL, H. 1978. Morphometric analysis of *Crocodylus porosus* from the North Coast of Arnhem Land, Northern Australia. *Aust. J. Zool.* **26**, 1–27.

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ADDENDUM

New geological and biostratigraphical evidence seems to indicate that the level of the Spanish young *Bernissartia* must be located in the early Barremian.