

AN EARLY CRETACEOUS FAUNAL AND FLORAL CONTINENTAL ASSEMBLAGE :
LAS HOYAS FOSSIL SITE (CUENCA, SPAIN)

by

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ABSTRACT

The fossiliferous beds of Las Hoyas (province of Cuenca, Spain) are composed of limestones (probably Late Hauterivian). The main fossiliferous facies consists of laminated limestone from a lake-basin plain with bottom waters perennially anoxic. The floral and faunal assemblage is similar to that of Montsech (prov. of Lérida, Spain), with divergences especially in the insects and some tetrapods. Bottom-dwelling invertebrates are scarce. Most of invertebrates are arthropods : three crustaceans and a relatively diversified entomofauna. The fishes are the main component of the vertebrate fauna both in number of individuals and diversity (13 different taxa). Among tetrapods the most abundant is a new genus of Caudata. Reptiles are represented by a chelonian, a little lizard and an atoposaurid crocodile. Finally, a new bird is reported from Las Hoyas, with an intermediate phylogenetic position between *Archaeopteryx* and Ornithurae.

RÉSUMÉ

Les couches à fossiles de Las Hoyas (province de Cuenca, Espagne) sont composées de calcaires d'âge Hauterivien supérieur - Barrémien inférieur, probablement de milieu lacustre. Le principal faciès fossilifère est fait de calcaires laminés qui proviennent d'eaux profondes anoxiques. L'assemblage floral et faunique est similaire à celui du Montsech (prov. de Lérida, Espagne), avec des divergences surtout dans les insectes et quelques tétrapodes. Les invertébrés benthoniques sont rares. La plupart des invertébrés sont des arthropodes : trois crustacés et une entomofaune relativement diversifiée. La faune de vertébrés la plus importante est composée par des poissons tant en nombre d'échantillons qu'en diversité (13 taxa différents). Parmi les tétrapodes, le plus abondant est un nouveau genre de Caudata. Les reptiles sont représentés par une tortue, un petit lézard et un crocodile atoposauride. Finalement, un nouvel oiseau est reconnu dans Las Hoyas, avec une position phylogénétique intermédiaire entre *Archaeopteryx* et les Ornithurae.

KEY-WORDS : LOWER CRETACEOUS, LACUSTRINE ENVIRONMENT, SPAIN, MEGAFLORA, CRUSTACEA, INSECTA, FISHES, CAUDATA, CHELONIA, LACERTILIA, CROCODYLIA, AVES.

MOTS-CLÉS : CRÉTACÉ INFÉRIEUR, MILIEU LACUSTRE, ESPAGNE, MÉGAFLORE, CRUSTACEA, INSECTA, POISSONS, CAUDATA, CHELONIA, LACERTILIA, CROCODYLIA, OISEAUX.

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INTRODUCTION : GEOLOGICAL SETTING

The Las Hoyas fossil site is situated about 20 km east of Cuenca, in the Castellana Branch of the Iberian Range (fig. 1A).

The studied fossiliferous beds are included in a succession predominantly composed of carbonate sediments that can be correlated with the Limestones of the La Huérguina Fm. (Vilas *et alii* 1982), one of the formations established in the lowest part of the Lower Cretaceous ("Weald") in the southwestern Iberian Range (Mas *et alii* 1982). We have no data on the age of the Las Hoyas outcrop, but the La Huérguina Fm. contains a very rich charophyte association, studied in a place close to this area, suggesting an age within the Late Hauterivian-Early Barremian time-span (Vilas *et alii* 1982).

Exposure of the "Weald" strata in Las Hoyas is poor but, tentatively, five units can be distinguished (fig. 1B).

- Contreras Fm. Red and gray clays with intercalations of sandstones. They are interpreted as fluvial deposits. The boundary between this unit and the overlying Utrillas Fm. (Albian-Early Cenomanian) is a disconformity.

- Unit IV. Limestones with some marly intercalations in the upper part. They are considered deposits of shallow lakes.

- Unit III. Limestones with laminites. They are the sediments of the Las Hoyas fossil site.

- Unit II. Greenish shales and silts alternating with limestones, sometimes channelized, and some thin carbonaceous intercalations. They are interpreted as palustrine, marsh and shallow lake deposits.

- Unit I. Reddish clays and silts with sparse limestones. They are interpreted as a predominantly palustrine deposit with pedogenetic structures. The unit is disconformably underlain by the Middle Jurassic Chelva Fm.

Units I, II, III and IV correspond to La Huérguina Fm.

Unit III is characterized by the presence of laminites, also appearing in a level of the upper part of unit II. Laminites in unit III contain relatively frequent

vertebrate remains, especially fishes, and other fossils such as crustaceans insects and very abundant plant remains.

THREE FACIES can be distinguished in fossil-bearing unit III, sharing mostly gradational boundaries (fig. 1C).

- Massive limestones. Packstones with peloids and sand-sized fragments of Charophyte stems. Occasionally, in the base of these beds, levels of gastropodal wackestones appear. The environment of deposition corresponds to a shallow lacustrine one, well oxygenated and situated above the photic zone. Gastropodal wackestones represent a slightly deeper subfacies.

- Flaggy limestones, sometimes nodular. Ostracodal mudstones with occasional thick laminations, laterally grading to convolute laminations. This facies was probably deposited in the gentle upper slope of a lake.

- Laminated limestones. Mudstones with laminations containing abundant fossils. Laminae are very continuous laterally and the quality of fossil vertebrate preservation is good. The environment of deposition corresponds to a lake-basin plain. Laminations developed as a response to periodic fluctuations in the lake biosedimentary system. Preservation of delicate laminations, which do not show signs of either bioturbation or disturbance by wind-induced currents, and good preservation of fossil fishes in an undisturbed state usually occur in relatively deep lakes whose bottom waters are perennially anoxic. This bottom anoxia inhibits the development of benthic epi- and infaunal communities.

Four subfacies can be differentiated in the laminated facies :

- thin laminites. They are the commonest laminated facies ;

- thick laminites. Probably formed in connection with periods of high water discharge ;

- black, slightly carbonaceous and clayed laminites with very abundant floated terrestrial macrophyte remains. They may be considered deposits related to mouths of small feeding streams ;

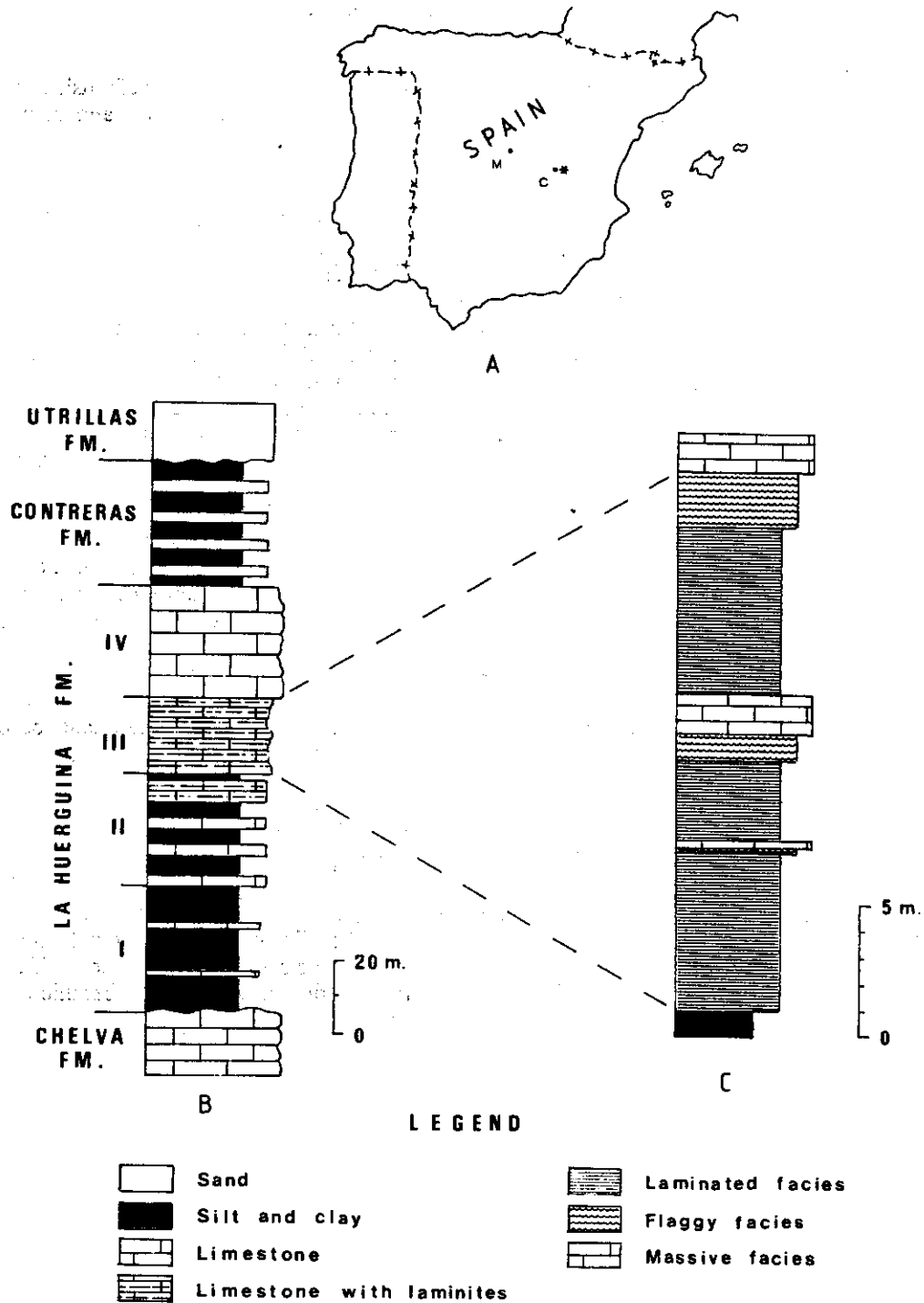


Fig. 1 - A) Sketch map of Spain showing Las Hoyas fossil site location. M : Madrid, C : Cuenca ; * : Las Hoyas. B) "Weald" lithostratigraphic section in Las Hoyas area. C) Sedimentological log of unit III.

Carte schématique de l'Espagne avec la situation du gisement de Las Hoyas. M : Madrid ; C : Cuenca ; * : Las Hoyas. B) Colonne stratigraphique du "Weald" dans la région de Las Hoyas. C) Schéma sédimentologique de l'unité III.

- laminites with recumbent microfolds and micro-faults. They appear to have been formed by the movement of sediments, only partially consolidated, down the slopes of the lake.

A typical facies sequence, thickening and coarsening upwards, consists of laminated, flaggy and massive limestone (fig. 1B). The origin of these shallowing upwards sequences can be explained by fluctuations in water depth produced by aggradation or by

progradation basinward of a bench sequence (Murphy & Wilkinson 1980).

Sediments of unit III were deposited from a hard-water lake, with very little terrigenous influx and non-coincident margins (Donovan 1975). During deposition of laminated facies, the lake had perennially anoxic bottom water resulting from meromoxis, that is, the lake water column was stratified, with an upper epilimnion well oxygenated and a lower hypolimnion with anoxic waters.

I - COMPOSITE LIST OF MEGAFLOTA

PTERIDOPHYTA Filicales

Weitchselia reticulata (STOKES & WEBB) FONTAINE emend. ALVIN.

Thirteen specimens have been identified as members of this species. We can observe, in all of them, elliptical, small and slightly falcate pinnules, attached by their entire base, with a patent midvein. The reticulate venation is not present in all specimens, due to their state of preservation, but they are easily recognizable by means of their opposite-row pinnules, setting in angle one to each other, forming a characteristic butterfly pinnate structure.

Cladophlebis browniana (DUNKER) SEWARD

Only four specimens have been found. One of them shows a complete pinna without terminal and some basal pinnules. The preservation is not usually good, but we can clearly see pinnae with straight or slightly-falcate linear pinnules, some of which have a crenulate margin, attached by their entire base. Bifurcation of venation occurs once.

PINOPHYTA Cycadopsida

Zamites sp.
Williansonia sp.

Pinopsida (Coniferae)

Sphenolepis kurriana (DUNKER) SCHENK
pl. 1, fig. 8

It is scarcely present ; only two specimens have been collected in a very good preservation state. The most complete one consists of rather short and rigid twigs. They have the main stem rather obliquely and bear imbricate scale-shaped spirally disposed leaves with spreading out incurved tips, all of them usually thick.

Brachyphilum speciosa (PONSEL) SAPORTA emend.
BARALE

It is represented by the terminal part of an ultimate order branch, slightly flexuose ; it has helically arranged small leaves with basal cushion. The free part of the leaf is shorter than the leaf cushion width.

Cupressinocladus micromerum (HEER) PAIS

Only one specimen has been found. Due to its characteristics it could be considered as a member of this species. It shows alternate branches with opposite, small, rounded and imbricated leaves. Ultimate order branches are short and proximated.

Incertae sedis

Montsechia vidali (ZEILLER) TEIXEIRA
pl. 1, fig. 9

The numerous found specimens show unverticillated, sessile, elongate leaves, with all undeveloped up-

wards incurved limb, rounded in the tip and disposed in small groups, opposite in the last order's axis. At the same time, they are inserted oppositely or suboppositely on the larger axis.

II - ARTHROPODA

CRUSTACEA

Pseudoastacus llopsi (pl. 1, fig. 9).
Oplophorus roselli
? Family Eryonidae

The Crustacean fauna of Las Hoyas is similar to that of Montsech, with two common species, *Pseudoastacus llopsi* and *Oplophorus roselli*. On the other hand, another small crab with a large cephalothorax has been found in Las Hoyas, that could belong to the Family Eryonidae.

INSECTA

Odonata
pl. 1, fig. 4

This order is not common in this locality but is represented by extremely well preserved specimens. The information from this locality is restricted adults (wings) for no larva specimens have yet been encountered.

In the late Jurassic-Early Cretaceous deposits the commonest suborders are : *Anisozygoptera*, *Zygoptera* (damselflies) and *Anisoptera* (dragonflies). The isolated wings found in the deposit belong to this last suborder, and more specifically to the extinct family Aeschnidiidae HANDLIRSCH, 1906-1908. Rests of other families (Aeschnidae (?) LEACH (1815)) have also been found.

The wing sizes of individuals in this group range from 35 mm to 80 mm.

The adults in this suborder, usually predators, are not confined to the parts nearest to the water, unlike the nymphs, which are almost exclusively found there (Aguesse 1968).

Ephemeroptera

Only one representative of this group has been found. It is a fairly developed larva (28.5 mm). The presence of three caudal filaments allows to refer it to this order. The specimen presents apical abdominal terga, side abdominal gills and long thin legs. It belongs to the Leptophlebiidae WESTWOOD (1840), that appears for the first time in the fossil record in the Middle Jurassic. This group has a lotic depositional and erosional habitat, and a tendency to swimming, clinging or sprawling (Edmunds 1978).

Blattodea

This order, with a very important representation in other Jurassic-Cretaceous deposits, has provided us with few specimens of detective preservation.

The cockroaches found are adults. The biggest (29.5 mm) has multiarticulated feelers and long, densely veined wings. The clavus (a characteristic part of the wings in this group) is long. All the specimens belong to the family Mesoblattinidae HANDLIRSCH (1906-1908) that although it appears in Upper Carboniferous deposits, reached its peak in the Jurassic-Early Cretaceous.

Nowadays, most of the members of this order belong to tropical climates.

Hemiptera
pl. 1, fig. 6

This order presents two suborders : Homoptera and Heteroptera, widespread in the Early Cretaceous. At the moment, only Heteroptera have been found in deposit, and all the specimens belong to the Hydroco-

risae group. The families Notonectidae LEACH (1815), Naucoridae FALLEN (1814) and Corixidae LEACH (1815) stand out, and one subfamily, the Velocorixinae POPOV (1986), has been identified within the latter. Most of specimens show legs adapted to swimming.

Most of the insects found in the deposit belong to this aquatic group.

Raphidioptera

It is represented by two incomplete specimens. This group is rarely found in deposits of the same age.

The examples found belong to the family Mesoraphidiidae MARTYNOV (1925). The most complete of them has a wing, the prothorax, the head and the long multi-articulated feelers.

Mecoptera

Specimens of this order appear for the first time in the Lower Permian. This group, like the above men-

tioned, is not very developed during the Early Cretaceous.

Only one specimen (of excellent preservation) has been found. It belongs to the extinct subfamily Orthoplebiinae HANDLIRSCH (1906-1908) of the Panorpiidae LEAY (1821) ; (in Sukatsheva 1985).

Coleoptera pl. 1, fig. 5

This group is the second in number of specimens, all the specimens coming from outside the basin (terrestrial). The beetles belong to the suborder Archostemata (Family Cupedidae LACORDAIRE (1857) and Ademosynidae (?) PONOMARENKO (1968).

This order is nowadays the one having the largest number of species. A wide range of sizes can be observed in the deposit : from 5 mm to 38 mm.

III - PISCIFORMES (see table 1)

PISCES		
ACTINOPTERYGII	Amiidae	"Leptolepidae"
Pycnodontiformes	<i>Vidalamia catalunica</i>	? <i>Ascalabos voithi</i>
Genus incertae sedis	<i>Urocles woodwardi</i>	Chanidae
Semionotidae	? <i>Amiopsis</i> sp	<i>Rubiesichthys gregalis</i>
<i>Lepidotes</i> sp	Macrosemiidae	Teleostei ind.
Caturidae	<i>Notagoqus ferreri</i>	ACTINISTIA
<i>Caturus</i> sp	<i>Notagoqus</i> sp	Coelacanthidae
	Pleuropholidae	? " <i>Holophaqus</i> " <i>leridae</i>
	<i>Pleuropholis</i> sp	

Tabl. 1

ACTINOPTERYGII
Pycnodontiformes
genus incertae sedis
pl. 2, fig. 8

REFERRED SPECIMEN :

UAM :2 plates represented one by some dissociated skull bones (frontal, premaxilla) and an isolated

dentalos-plenial, the other by a fragmentary body. (UAM, collection of the Universidad Autónoma de Madrid).

The dentalosplenial reaches 15 mm in length. The teeth are arranged into 3 regular longitudinal rows. The mesial one (main one) is formed by the largest teeth, the lateral one by the weakest teeth. The teeth of the mesial row (the so-called paved teeth) are 2 or 3 times wider than long. Those of the medio-lateral and of the lateral rows are hearily hemispherical, scarcely wider than long. Each row has about 10 teeth with a completely smooth surface, asymmetrally worn. A nearly central groove is bordered by a fold which is not crenulated.

A generic identification of that dentition would be untimely because a regular disposition into 3 rows is found in many pycnodonts. It should be observed that the *Coelodus* species from the Montsech presents a similar disposition but the teeth are crenulated.

Semionotidae
Lepidotes AGASSIZ, 1832
Lepidotes sp.
pl. 2, fig. 1

REFERRED SPECIMEN :

UAM : 3 isolated skulls and 2 complete fishes ;
ADR : about 10 partial or nearly complete specimens.
Most of them are juvenile. The largest one, adult or subadult, reaches a standard length of about 140 mm (ADR, collection of Mr. A. Diaz-Romeral, Cuenca).

The Las Hoyas *Lepidotes* is a fusiform but relatively deep-bodied fish with a well marked caudal peduncle and a weakly forked caudal. In a juvenile individual about 54 mm in standard length, the maximum height, situated halfway between the occiput and the dorsal fin, reaches about 2/5 of the standard length, the caudal peduncle being equivalent to the half of maximum height. The skull length represents one third of the standard length but the proportional changes with the increase of size seem considerable.

The major part of the cranial roof is constituted by the large frontals and parietals. Frontals are very slightly narrowed between the orbits. There is only a single pair of extrascapulars. The supraorbital canal extends into the parietals. It does not seem as if there were a postorbital link between the supra- and infraorbital canals.

The circumorbital series forms a complete ring around the eyes, one bone of the infraorbital series being in contact with the anterior supraorbital. Supraorbitals are elongated and straight. The infraorbital series possesses about 10 bones : 3 of them, antorbital included, are situated in front of the joint with the supraorbital. The infraorbitals are nearly square, higher than broad, except the ones situated behind the orbit which are narrow.

The suborbital series includes only 2 plates arranged in a single row between the circumorbitals and the preopercular. The dorsal one is very small, the large ventral one is much higher than broad ; they are separated one from another by a chamfered joint.

The narrow, vertical preopercular is bent forward and downward. The opercular apparatus is complete ; the brachioistegal rays are not numerous (6 or 7). The gular plate is absent.

The lower jaw is short, the quadrato-mandibular articulation lying half way of the length of the orbit. The symphysis is shallow ; the coronoid process is strong, its height reaching 2/3 of the length of the mandibula. The maxilla is short, it extends posteriorly only to the anterior margin of the orbit, it is overlain by a narrow supramaxilla. The premaxillae have a short ascending process, the backward extension of which is hitherto unknown.

The teeth are slender and styliform including those of such internal bones as the vomer.

The squamation is of a ganoid type. The scales are thick and have a peg and socket articulation. The anterior-dorsal angles of the flank scales are protracted forward. The squamation extends to the middle of the length of the caudal dorsal lobe. A series of simple dorsal ridge scales is present before the dorsal fin. 27 to 28 scales rows are counted between the cleithrum and the caudal inversion.

All the fins are posterior to the middle of the standard length. The pelvics are slightly in front of the dorsal, the anal is opposed to the last rays of the same fin. The fins/scale formula is :

----- 16/17 -----
8 ----- 14/15 ----- 25 ----- 27/28

All the fins are bordered by basal and fringing fulcra. They are formed by very few thick rays. Fin ray counts are : D 7, AN 8, C 14.

The concentric disposition of the cheek plates, a complete opercular apparatus, the few branchiostegal rays, the absence of a gular, the short mouth and the shape of the mandibula, the presence of thick ganoid scales, the structure of the fins, the presence of basal and fringing fulcra are as many characters of *Lepidotes*. A complete circumorbital ring and the shape of the constituting elements, a suborbital series reduced to only 2 bones, the number of transversal scale rows and the fins/scales formula are a combination of characters specific of the Las Hoyas specimens.

Among the numerous species of the genus, the *Lepidotes* from Las Hoyas looks like *L. minor* from the Purbeckian of Dorset (Great Britain) by the low number of suborbitals (2). McCune (1986) has defined the genus *Semionotus* on the presence of a single suborbital and, on the basis of that character, has identified as *Semionotus* the specimens previously described under the name *L. minor*. Some of the individuals illustrated by Woodward (1916-1919) and Jain & Robinson (1963) present a suture which delimits 2 suborbital plates as in the specimens from Las Hoyas. It should be remembered that it is not unusual to observe variations of the number of suborbitals related to the individualization of the dorsal suborbital (Jain & Robinson 1963, Wenz 1967). The discussion on the validity of such a character is beyond the scope of this study. Nevertheless the suborbital disposition of the *Lepidotes* from Las Hoyas is comparable with that of *Semionotus* (= *Lepidotes*) *minor* defined by McCune. On the other hand, the number of the transversal scale rows and the fins/scales formula allow to distinguish.

Semionotids are known at the Montsech by a large form, *L. ilergetis* (cf. Sauvage 1903) and by a small one not yet described and recorded in the Museo de Geología del Seminario at Barcelona. The high number of transversal scale rows and the back position of the unpaired fins of the specimens from Las Hoyas are comparable with the little form from the Montsech. The identity of the 2 forms needs to be confirmed. If it is real, this small *Lepidotes* would be exceptional at the Montsech and relatively frequent at Las Hoyas.

Caturidae
Caturus AGASSIZ, 1834
Caturus sp.

REFERRED SPECIMENS :

UAM : Crushed and more or less dissociated remains of a medium-sized fish (nearly 20 cm in standard length).

The buccal opening is large, the quadrato-mandibular articulation lying beyond the posterior border of the orbit. The mandibula is low at the level of the symphysis and bears a weak coronoid process situated posteriorly. The gular is large.

The teeth are long, slender and sharp. A little cap made of an enamel substance which is different from that of the rest of the tooth covers its apex.

The scales are thin and rounded in outline. They are largely imbricated and the overlapped surface is of an amioid type.

The fins, at least the dorsal and caudal ones, are bordered by fringing fulcra. The pectorals are very large, the pelvics are opposed to the anterior border of the dorsal and the anal begins under the posterior part of the same fin, the dorsal has a triangular shape.

The combination of the above-mentioned characters allows to identify that specimen as *Caturus*. For the moment, nothing suggests a close relationships with *Caturus tarraconensis* from the Montsech or with any of the other species of the genus.

Amiidae

The amiid assemblage comprises at least 2 genera. One, a large fish known by 2 incomplete specimens, has been referred to *Vidalamia catalunica*. The other, a tiny little fish represented by some juvenile individuals, has been identified as *Urocles woodwardi*. The presence of a third genus still needs confirmation.

Vidalamia WHITE & MOY THOMAS, 1941

Vidalamia catalunica (SAUVAGE, 1903)

REFERRED SPECIMENS :

ADR : 2 incomplete specimens. ADR 1 includes the caudal fin and the posterior part of the body down to the last rays of the anal. ADR 2 is represented by a very poorly preserved head and a large part of the trunk, the caudal is missing.

The axial skeleton is composed of vertebrae, the lateral walls of which are smooth or scarcely granulated. The vertebral centra are monospondylous in the trunk region (27 vertebrae) and diplospondylous in the postabdominal region (at least 12 vertebrae). The diplospondyly is of an alternating type (a half-centrum bearing the neural arch and a half-centrum the haemal arch), at least with regard to the centra which take part in the support of the caudal exoskeleton.

The caudal endoskeleton is characterized by the high number of vertebrae : 9 diplospondylous vertebrae of an alternating type, 2 monospondylous vertebrae and 17 or 18 centra bearing hypochordal elements or without vertebral extensions (terminal centra) are counted from front to back. The number of hypochordal elements (haemal spines + hypurals) is 18 or 19, out of which at least 9 true hypurals. The number of epichordal elements (neural arches + neural spines) is low, the last haemal arches being supported by the monospondylous vertebra 2, which is probably the ural vertebra 1. The epurals are very numerous (9 or 10).

The scales are of an amioid type.

The dorsal fin is elongated (26 fin radials) ; the anal is short (7 or 8 fin radials). The pelvics are situated just in front of the boundary between mono- and diplospondylous vertebrae.

The combination of mono- and diplospondylous vertebrae and the presence of amioid scales are characteristic of all amiids. The presence of smooth lateral walls in the vertebrae and of an elongated dorsal occurs in some of them only, including *Vidalamia*. The caudal endoskeleton characters, especially the high number of epurals, are particular to *Vidalamia* (cf. Wenz 1971). As far as we know, nothing allows to exclude the Las Hoyas specimens from the species *V. catalunica* from the Montsech.

Urocles JORDAN, 1919
Urocles woodwardi (SAUVAGE, 1903)
pl. 2, fig. 2

REFERRED SPECIMENS :

UAM : 2 juveniles individuals (26 and 32 mm in standard length). ADR : some specimens.

It is a small fish, short and with a stout head : the maximum height of the body, nearly equal to the

length of the head, represents slightly less than the third of the standard length. The caudal peduncle is equal to 3/5 of the maximum height.

The length and the shape of the mandibula, the aspect of the maxilla and premaxilla, the presence of numerous brachioistegal rays (at least 15) and of a large gular, the crescent-shaped preopercular correspond well with the style of amiids.

The axial skeleton includes 23 or 24 monospondylous vertebrae out which 3 are postabdominal, 12 diplospondylous vertebrae (18 half centra of a normal diplospondyly type + 6 half centra of an alternating type), 2 monospondylous vertebrae and 2 or 3 vertebrae supporting hypochordal elements only. The caudal endoskeleton is characterized by a relatively low number of the vertebrae supporting the caudal exoskeleton (10 or 11), of the hypochordal elements (15 haemal spines + hypurals) and mainly of the epurals (4 or 5).

The scales are of an amioid type.

The fins are all without fulcra. The small pelvics are just in front of the dorsal which is itself situated on the second half of the body without the caudal fin. The anal is opposed to the posterior quarter of the dorsal and continues beyond the posterior margin of the latter fin. The dorsal is relatively short : 14 fin radials supporting 2 + 14 rays. The anal is also short : 9 fin radials supporting 2 + 8 rays. The caudal fin presents a rounded posterior border. It is formed by dorsal and ventral unsegmented rays and by about 15 segmented rays.

Given the individual variations in amiids and the juvenile characters of the individuals observed here, the vertebral formula, the axial skeleton characters, more particularly the number of epurals, the position and the extension of the fins do not allow to distinguish specifically the Las Hoyas specimens from *U. woodwardi* from the Montsech. Only a more abundant material from the Montsech as well as from Las Hoyas will allow us to know whether *U. woodwardi* represents or not a juvenile type of *Amiopsis* sp. which is one of the large amiids of the Montsech (Wenz 1968).

? *Amiopsis* KNER, 1863

REFERRED SPECIMENS :

UAM : 2 skulls and 1 fragmentary body.

These are small fishes displaying characters common to both genera *Urocles* and *Amiopsis*, such as the presence of monospondylous and diplospondylous vertebrae, lateral walls of vertebral centra strengthened by a strong longitudinal trabecule, a relatively short dorsal fin (14 fin radials). However the shape and the extension of the infraorbitals, specially of the one situated at the postero-ventral angle of the orbit is characteristic of the genus *Amiopsis* only.

Macrosemiidae

REFERRED SPECIMENS :

UAM : 4 specimens ; ADR : several individuals. All the specimens except one are juvenile individuals which are identified as *Notagogus ferreri*. One individual, adult or subadult, could not be determined specifically.

Notagogus AGASSIZ, 1835
Notagogus ferreri WENZ, 1964
pl. 2, fig. 3

It is a small fish ranging from 15 mm to 30 mm in standard length. The head is stout. Its length, nearly longer than the maximum height of the body, represents more than a third of the standard length. The dorsal is elongated (60 % of the dorsal line) and divided into 2 subequal and rounded lobes. The pelvics are opposed to the posterior region of the anterior dorsal and the anal begins just beyond the origin of the posterior dorsal.

All the preserved skull elements are typical of the macrosemiids. The preorbital region is elongated. The mouth is short, the quadrato-mandibular articulation lying slightly beyond the anterior border of the orbit. The frontals are narrow through most of their length and they widen out suddenly behind the orbit. The parietals are large and subequal. The opercular apparatus is complete. There are about 8 branchiostegal rays, the gular is absent. The distal ceratohyal has a distinctive shape : it is compact and has a fan-shaped posterior end. The ventral border of the mandibula presents the characteristic concavity of the macrosemiids. The premaxilla, the maxilla and the mandibula are provided with small stout teeth with rounded apex. The cleithrum is very large.

The axial skeleton includes 2 or 3 vertebrae hidden under the opercular + 24 vertebrae visible

beyond the cleithrum out of which 12 are abdominal. The vertebral centra are well ossified, completely cylindrical in shape. They are a little longer than high and very slightly constricted in the middle. Only the 3 terminal centra are formed by dorsal and ventral crescent-shaped hemicentra. The neural arches are paired throughout the axial skeleton.

All the fins, except the 2 lobes of the caudal, are without fringing fulcra. The pelvic includes 7 rays, the pectoral at least 10. The anterior dorsal fin possesses one short unsegmented ray connected with the first radial and 11 segmented but unbranched rays. The posterior lobe of the dorsal has 10 or 11 segmented and unbranched rays (juvenile character). The endoskeleton of the anal includes 7 radials themselves preceded by a stout plate with 3 anterior spines. The exoskeleton has 2 short unsegmented rays followed by 6 or 7 segmented rays which branch only once. The endoskeleton of the caudal has hypochordal elements which are not very modified and few in number (5 or 6). The caudal is weakly forked with a posterior border nearly straight. There are 10 rays (4 in the dorsal lobe, 6 in the ventral one).

The fact that the dorsal fin is divided into 2 rounded and subequal lobes shows that the macrosemiid of Las Hoyas is a *Notagogus*.

The advanced degree of vertebral ossification is only found in *N. ferreri* (Wenz 1964, Bartram 1977) just as, in the present state of our knowledge, the presence of a large endoskeletal anal plate. All the other characters (vertebral formula, presence of 2 subequal and rounded dorsal lobes, position, extension and formula of the fins, a low number of caudal rays) are consistent with *N. ferreri* and only with it.

Notagogus sp.

LH 094 is an adult or subadult individual because of the aspect of the rays (number of distal segments and branching), of the ossification of the scales and of the size (41 mm in standard length ; that length changing from 60 mm to 120 mm according to the species).

That *Notagogus* is distinguishable from *N. ferreri* by the high number of the caudal rays (13 distributed 5/8) and from all *Notagogus* species by the presence of basal and fringing fulcra in the posterior lobe of the dorsal fin and by the low number of transversal scale rows (28 or 29 instead of 34 to 38).

New research will be necessary to determine whether this *Notagogus* is specifically distinct from the others or if it is the adult stage of *N. ferreri*.

Pleuropholidae
Pleuropholis EGERTON, 1858
Pleuropholis sp.
pl. 2, fig. 5

REFERRED SPECIMENS :

UAM : 1 specimen , ADR : 4 or 5 specimens.

It is a small fish reaching 27 mm in standard length (UAM LH 771). The length of the head, nearly equal to the maximum height of the body, represents a quarter of the standard length. The caudal peduncle is narrow and equal to the third of the maximum height of the body. The dorsal and anal fins are opposed and situated at the posterior third of the standard length. The pelvics are hardly nearer to the pectorals than the anal. The caudal is forked.

The skull features are characteristic of *Pleuropholis* especially by the presence of a very large orbit, of a short and upturned mouth (the quadrato-mandibular articulation lying in front of the anterior margin of the orbit), by the presence of a very high maxilla with an oral border curved and apparently edentulous, of a single supramaxilla and a two-branched preopercular, the horizontal branch being much longer than the vertical one.

The scales are of a ganoid type, those of the flank remarkably high : they are 7 or 8 times higher than longer. The fins/scales formula is

$$\begin{array}{ccccccc} & & 19 & & & & \\ - & - & - & - & - & - & - \\ 8 & & 17 & & 27 & & 30 \text{ (cf. LH 771)} \end{array}$$

The dorsal includes 7 or 8 rays, the anal 9, the caudal 11 or 12 distributed I-4/5-5-I. All the fins are bordered by large and numerous fringing fulcra.

Further findings will be necessary to describe the *Pleuropholis* from Las Hoyas. It should be observed than in spite of its small size the presence of well developed scales and the aspect of fin rays bears evidence that the specimen is in a relatively advanced stage of growth.

"Leptolepidae"
? Ascalabos voithi MÜNSTER, 1839
pl. 2, fig. 4

REFERRED SPECIMENS :

UAM : About 20 specimens ranging from 30 mm to 70 mm in standard length ; ADR : nearly the same number of specimens.

They are small adult or subadult fishes. The body is relatively elongated with a well marked caudal peduncle. The length of the head represents more than one quarter of the standard length, the maximum height of the body only the fifth. The pelvics are situated halfway between the tip of snout and the origin of the caudal. The dorsal is short (11 or 12 radials, the first one composed) and begins just after the pelvics. The anal is also short (7 or 8 radials) and posteriorly situated (nearer to the caudal than to the pelvics). The caudal is deeply forked. There are no fringing fulcra.

The skull is medioparietal. The mouth is short, the quadrato-mandibular articulation being situated at the level of the middle of the orbit. The dentalosplenic is provided with a strong coronoid process, situated in front. There is an independent retroarticular. The large maxilla has a curved oral margin and a long anterior process. It is overlain by 2 very developed supramaxillae. The presence of teeth seems probable but needs to be confirmed. The preopercular sensory canal emits a few unbranched tubules. The distal ceratohyal is perforated.

The average number of vertebrae is 42 or 43 out of which 16 or 17 are postabdominal. The lateral walls of the vertebral centra are strengthened by longitudinal trabecules. There are epineural intermuscular bones up to the level of the dorsal fin and epipleural bones in the middle region of the trunk. The caudal endoskeleton is incompletely known. The last preural vertebra and the ural vertebrae are independent one from another. There are, at least, 6 hypurals and 4 uroneurals, the anterior one reaching, in front, the pleural vertebra 3. There are 3 epurals. The caudal exoskeleton has 19 principal rays distributed 1-9-8-1. There are dorsal and ventral caudal scutes. The scales are cycloid.

All these characters allow to put close together the specimens from Las Hoyas and *Ascalabos voithi* from the Montsech. However, owing to the partial knowledge of the caudal endoskeleton and to the differences in the vertebral and fin formula, the fishes from

Las Hoyas are only provisionally and with doubt identified as *A. voithi*. Only forthcoming research could allow to know whether it is necessary to establish a specific, or even generic, distinction between the Las Hoyas and Montsech specimens.

Chanidae

Rubiesichthys WENZ, 1984

Rubiesichthys gregalis WENZ, 1984
pl. 2, fig. 6

REFERRED SPECIMENS :

UAM : About 10 specimens ; ADR : present in the collection in a undetermined number.

It is a small-sized fish, the largest individuals being less than 50 mm in standard length. The body shape is elongated. The length of the skull, longer than the maximum height of the body, represents nearly the quarter of the standard length. The pelvics, which are just in front of the origin of the dorsal, are situated halfway of the standard length ; the anal fin is hardly nearer to the pelvic than to the caudal. The latter fin is deeply forked. The dorsal and anal fins are short and triangular.

The greatest part of the skull roof is constituted by large frontals which are not constricted between the orbit. A small supraoccipital separates the parietals on the mediodorsal line of the skull (lateroparietal skull).

The buccal opening is short, the mouth being entirely situated in front of the anterior margin of the orbit. The premaxilla is relatively large ; the maxilla, short, is formed by a thin oval posterior plate prolonged forward by a strong anterior process orientated antero-dorsally and almost as long as the main body of the bone. It does not seem as if there were a supra-maxilla. The mandibula is short and triangular. The coronoid process, very high, is situated at mid-length. All the bones are toothless.

The horizontal branch of the preopercular is much longer than the vertical one. In the same way, the symplectic and the quadratojugal process of the quadrate are strongly elongated antero-posteriorly. The quadrate is remarkably small. The opercular apparatus is complete and characterized by a hypertrophy of the opercular and a reduction of the subopercular.

The axial skeleton includes 39 or 40 vertebrae out of which 16 or 17 are postabdominal. The neural spines are not fused in the abdominal region. The epineural and epipleural intermuscular bones are present respectively in the abdominal region and in the middle of the trunk.

The caudal endoskeleton is only partially known. The last preural vertebra and the 2 ural vertebrae are independent one from another. There are 3 pairs of free uroneurals, the first one reaching, in front, the preural vertebra 2. There are at least 6 hypurals and the number of epurals is unknown. The caudal exoskeleton has 19 principal rays distributed 1-9-8-1. There are no fringing fulcra and no dorsal and ventral caudal scutes.

All these characters are found in *Rubiesichthys gregalis* from the Montsech (Wenz 1971). To be confirmed, the identification would require, however, a better knowledge of the caudal endoskeleton.

Undetermined Teleostei

It seems that a small primitive Teleostei, close to *A. voithi* by the skull characters but different by the shape of the body and the vertebral formula, does exist.

ACTINISTIA

Coelacanthidae

? "*Holophagus*" *leridae* (SAUVAGE, 1903)
pl. 2, fig. 7

REFERRED SPECIMENS :

UAM : 1 nearly complete fish and an isolated caudal fin with the supplementary lobe preserved.

It is a relatively small-sized coelacanth, reaching about 180 mm in length. The length of the head, nearly equalling the maximum height of the body, represents less than one quarter of the length of the fish without the supplementary lobe.

The skull, badly preserved, presents the general features common to all coelacanthids : such are the distribution of the dermal roofing bones into two shields, fronto-ethmoid in front and parietal behind, the shape of the palatoquadrate and the presence of

granulated teeth on the mesial surface, the presence of a dorsal preopercular (squamosal). The specimen of Las Hoyas is characterized by a short frontoethmoidal shield, more particularly in the area of the snout, and by the lack of ornamentation on the skull roof.

The pectoral fin has not been preserved. The pelvic one is situated slightly nearer to the posterior dorsal than the anterior dorsal fin. It is elongated and reaches the base of the anal fin posteriorly. The anterior dorsal fin has 7 stout rays, the first one being the longest. Spines, cut at their base, can be seen in the form of oblong impressions on the anterior rays of the fin. The posterior dorsal and the anal fins are lobed and have respectively 14 and 14 or 15 very thin rays. The caudal fin has 13 rays in its dorsal lobe and 12 in its ventral lobe. The supplementary lobe is composed of 25 thin rays.

The scales are ornamented with few, elongated, non-interrupted and largely spaced ridges (7 or 9 for a scale situated at the level of the anterior dorsal fin).

These characters are in good agreement with those found in the Upper Jurassic and Lower Cretaceous species referred to "*Holophagus*" (the validity of the genus "*Holophagus*" (= *Undina*) as it is defined nowadays is not supported by any serious criterion). The species "*H. leridae*" from the Montsech is also characterized by a small number of fin-rays, notably on the anterior dorsal and caudal fins. This character as well as the type of ornamentation of the scales allow to separate the Spanish coelacanthids from "*H. cirinensis*" and "*H. penicillata*". The skull of the studied specimens is rather poorly preserved, so the coelacanth of Las Hoyas is only provisionally identified as "*Holophagus leridae*".

IV - AMPHIBIA

CAUDATA

Family incertae sedis
new genus and species
pl. 1, fig. 7

REFERRED SPECIMENS:

LH 002 A and B, part and counterpart of specimen lacking only left fore limb and left hind limb. LH 005R A (is there a counter part?), complete specimen. LH 006R, skull, anterior vertebral column, limbs lacking. LH 001 B, complete, well preserved specimen. LH 003, complete specimen lacking right fore limb and right hind limb.

Slender bodied, delicately built salamanders ranging in size from 40 mm to 45 mm in estimated snout-vent length. Skull well ossified, all major bones present; presence of external gill skeleton indicates that animal was either perennibranchiate or larval. Limbs not reduced, shoulder and pelvic girdles well developed.

Premaxillae paired, posterior processes long, delicate toothed. Maxilla with prominent, squared-off dorsal (nasal) process, teeth present. Pterygoid extensive, triangular. Squamosal subtriangular, excavated posterolaterally. Quadrate overlapped laterally by

squamosal, a strong articulation for mandible present; lateral side somewhat hollowed out. Mandible relatively robust, toothed; angular apparently absent; temporomandibular articulation prominent.

Vertebrae amphicoelous, spool-shaped, interior of vertebrae hollow, notochordal foramen present. Rib-bearers double, widely separated throughout the column. Small but well-developed anterior basapophyses present. Neural spines long, thin, prominent, tubular, posteriorly-projecting, muscle crests extending along their length anteriorly, in most cases tips of neural spines appear to be finished in bone or to have only a tiny cartilage tip. Although the vertebrae are not very well preserved, enough remains to be reasonably certain that no spinal nerve foramina were present in the trunk vertebrae. In LH 006 the sacral region is not preserved; in the other specimens the sacral vertebra is at least the sixteenth, possibly the seventeenth vertebra. Caudal vertebrae with elongated, tubular neural and hemal spines, often with weak anterior muscle crests; tips of neural and hemal spines appear to be finished with bone or have only a tiny cartilage tip. Most specimens have caudal vertebrae well enough preserved to indicate that spinal nerve foramina were absent.

Ribs delicate and slender, with widely separated articulations for rib-bearers. Rib articulations not

webbed with bone. Rib length slightly longer than the centrum length of the vertebrae.

Scapula delicate, slightly expanded at humeral articulation, shaft relatively long. Ilium not well preserved, relatively slender.

The major limb bones are well preserved. Humerus and femur are slender, without obvious processes; proximal and distal ends are not much expanded and appear to lack distinctive features. Both humerus and femur are about the length of 2.5 vertebrae; in the smallest specimen they are about 2.2 vertebrae in length and about 2.7 in the largest specimen. Tibia, fibula, radius and ulna, are about half the length of femur and humerus; they are slender bones without distinctive morphology. Carpus and tarsus are not ossified. Metatarsals and phalanges are slender. No specimen has a complete hand preserved; the foot is well preserved and appears complete in LH 003 and the phalangeal count appears to be 2-3-3-3-2.

The Cuenca salamander is difficult to identify because it possesses few shared derived characters. The animal is likely to be related to salamanders below the plethodontoid and salamandroid levels because it seems to lack the presence of intravertebral spinal nerve foramina that characterize the latter groups (Edwards 1976; Hecht & Edwards 1976; Milner 1983). This is not surprising because among Mesozoic salamanders, only *Scapherpeton* is known to possess such foramina, and even here they are present only in the caudal vertebrae. The well preserved caudal vertebrae of the Cuenca form clearly lack any intravertebral nerve foramina, making it unlikely that there are such foramina in the less well preserved presacral vertebrae.

A second condition that tends to obscure the relationships of the Cuenca form is the fact that it is larval. Presence of four very well developed branchial arches indicates the larval state of this animal. Whether or

not this condition merely indicates that these individuals were larvae or that this was a paedomorphic form cannot be determined. Presence of a large, well-formed maxilla similar to that of *Palaeoproteus gallicus* (Estes, Hecht & Hoffstetter 1967) suggests that if the Cuenca taxon was paedomorphic, that it was so at a rather advanced level of development as compared with *Proteus* and other highly larval salamanders. The high number of branchial arches is primitive with respect to other salamanders except the Early Cretaceous *Hylaobatrachus*, which has five (Estes 1981).

The derived condition of long, slender posterior processes of the premaxillae indicates that the Cuenca salamander is not a cryptobranchoid. Known taxa that have long, slender posterior processes of the maxillae and lack intravertebral spinal nerve foramina include Prosirenidae, Proteidae, Batrachosauroididae. No characters, however, indicates that the Cuenca salamander belongs to any of these groups.

There are some derived characters that make the position of the Cuenca salamander difficult to assess. These include apparent fusion of the otic and exoccipital elements, apparent absence of a lacrimal, and apparent loss of the angular. If these characters are properly assessed, they are convergent on the plethodontoid condition. These three characters, however, are discordant with the three primitive characters that suggest a less derived position (lack of intravertebral nerve foramina, large pterygoid, and high number of branchial arches). Amphiumidae, for example, have lost the intravertebral nerve foramina that are present in other plethodontoids. Nevertheless, we consider it unlikely that the large pterygoid and the high number of branchial arches are reversals. For this reason we tentatively consider the plethodontoid-like derived characters noted above to be acquired independently of plethodontoids. If this is the case, the Cuenca salamander may belong to an as yet undefined group of salamanders that independently, by Early Cretaceous time, had acquired some significant derived characters present in plethodontoids.

V - REPTILIA

CHELONIA
Toxochelyidae
Toxochelyidae indet.
pl. 1, fig. 1

Two specimens have been found. They are characterized by the cruciform aspect of the plastron, the hyo-hyoplastral openings or fontanellae and the stylized form of their limbs. These traits are found in

certain types of the families Toxochelyidae, Macrobaenidae and Chelydridae. The absence of pleuro-peripheral fontanellae in one of the specimens, and perhaps also in the other, is a specialized character.

The "modern" Chelydridae are relatively abundant chelonians in the Miocene, and are known only since the Oligocene, excepting the rather problematic *Hangaiemys oburensis* (Sukhanov & Narmandakh 1974). This species could be a primitive Chelydridae (Broin 1977), but Sukhanov & Narmandakh (1974) and Mlynarski (1977) consider it as a Macrobaenidae. Recently, Zangerl (1980) has discussed the evolution of the Toxochelyidae, providing new aspects of the primitive freshwater habitat in North American forms. Nessov (1986) reports that in the Lower Cretaceous of Soviet Central Asia there are freshwater forms such as *Kirgizemys* with intermediate characters between Macrobaenidae and primitive forms of Toxochelyidae. There are also freshwater forms such as *Hangaiemys* or estuarine forms such as *Anatolemys*, close to the Plesiochelyidae or the primitive Toxochelyidae.

The features observed in the chelonians from Las Hoyas suggest that we are dealing with a primitive non-marine Toxochelyidae. It would be necessary, however, to confirm such an hypothesis with hitherto unobserved characters which can only come to light after cleaning the skull and uncovering the external surfaces of the plastron and carapace, or by means of new specimens from the same site.

SQUAMATA
Lacertilia
Lacertilia indet.
pl. 1, fig. 2

new genus and species
text-figs. 2 & 3

A new significant fossil bird has been found at Las Hoyas. It is an almost complete articulated little specimen (LH 022R) that lacks the skull and manus. This specimen represents a hitherto unknown level of orga-

A small lizard has been found in Las Hoyas. The teeth implantation is pleurodont. The coronoid is relatively large, and the Meckelian fossa very distinct. The interclavicula is cruciform, medially expanded. The clavicle is curved and fenestrated anteriorly. The limbs are well developed. The vertebrae are procoelous. The first caudal vertebrae has a transverse process very developed. The caudal autotomy can be observed.

CROCODYLIA
Atoposauridae
Atoposauridae indet.

A small atoposaur represents the only evidence of the Crocodylomorpha in Las Hoyas. The specimen (195 m in length) is poorly preserved. The skull bones are missing and the tail is broken away. The specimen has some primitive features present in the atoposaurs: number of cervical vertebrae less than nine, tibia about the same length as femur, ventral trunk scutes absent, and two rows of dorsal scutes. This small crocodile shares with the atoposaurs the following apomorphic traits: antero-posterior distal development of the transverse processes, glenoid surface dorsally directed in the coracoid, anterior process of ilium relatively short or absent, and probably osteoderm outline subtrapezoidal (Buscalioni & Sanz in press). The specimen, which is half the size of that of *Montsecosuchus* (= *Alligatorium depereti*), resembles the latter in the thickness of the humerus, the relative development of the transverse processes and a strong reduction of the anterior iliac process.

VI - AVES

nisation of birds, with an intermediate phylogenetic position between *Archaeopteryx* and the Ornithurae (Sanz *et alii* 1988). This new fossil bird is the sister-group of the Ornithurae, a clade characterized by the presence of a pygostyle (fig. 2) and a strut-like coracoid (fig. 3).



Fig. 2 - The new fossil bird from Las Hoyas (LH 022R). Py : pygostyle.
Le nouvel oiseau fossile de Las Hoyas (LH 022R). Py : pygostyle.

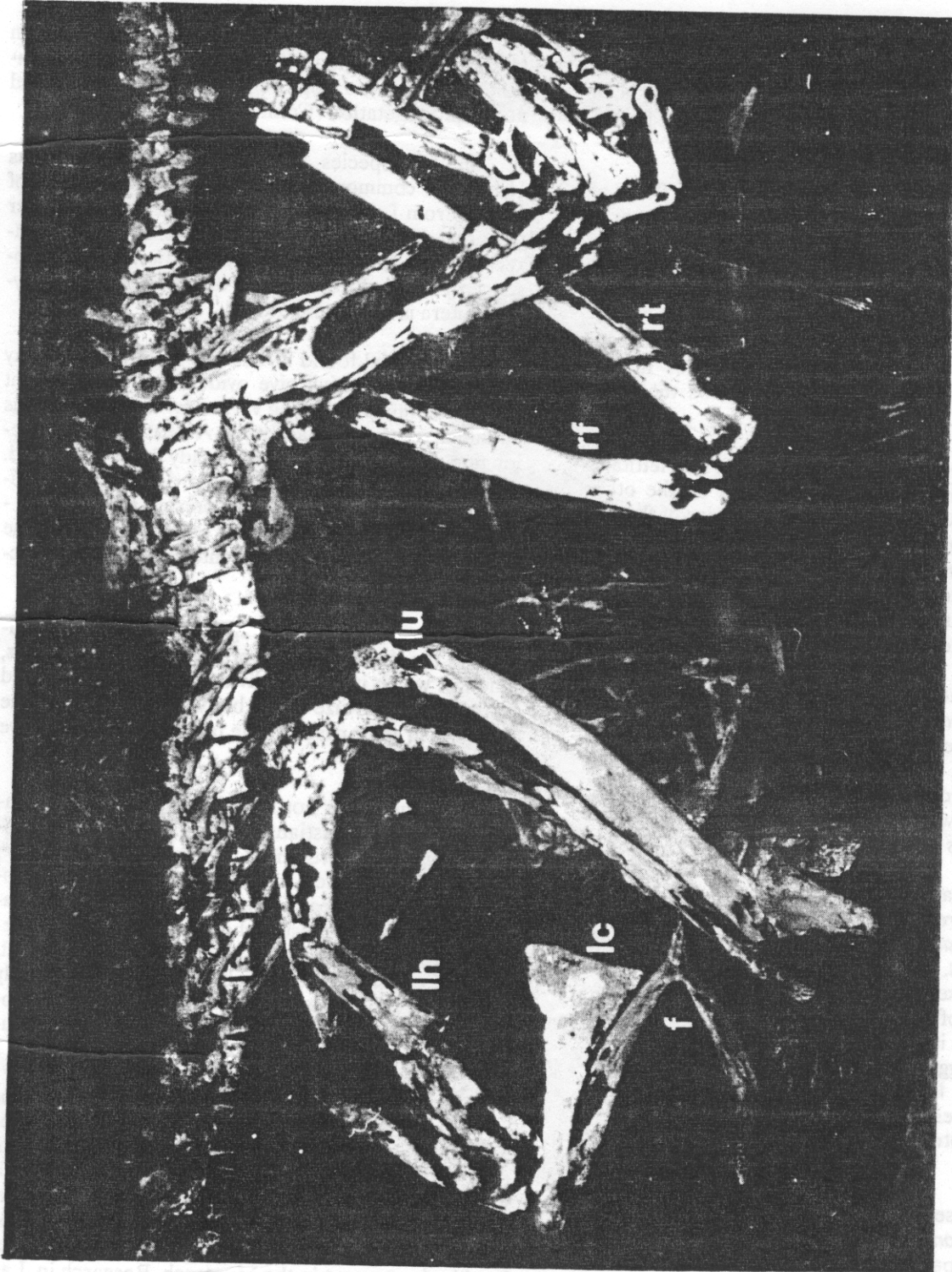


Fig. 3 - Ultraviolet-induced fluorescence photograph of the thoracic region of the new Lower Cretaceous bird from Las Hoyas (LH 022R).
f : furcula ; lc : left coracoid ; lh : left humerus ; lu : left ulna ; rf : right femur ; rt : right tibia.

Photographie de fluorescence induite par lumière ultraviolette de la région thoracique de l'oiseau du Crétacé inférieur de Las Hoyas (LH 022R). f : fourchette ; lc : coracoïde gauche ; lh : humérus gauche ; lu : ulna gauche ; rf : fémur droit ; rt : tibia droit.

CONCLUSIONS

The floral and faunal similarity between Montsech (Barale *et alii* 1984) and Las Hoyas is significant. Many forms restricted to Montsech outcrops have been found in Las Hoyas. These mainly include plants, crustaceans and fishes.

There is a great resemblance between the floras of Las Hoyas and La Pedrera de Rubies beds. Five species are present in both beds and they have in common the scarcity of the Filicales. Furthermore, *Frenelopsis* is very abundant in Cretaceous beds, but is rare in the Montsech and it is absent at Las Hoyas. Nevertheless, there exist some differences such as the absence of Pteridospermales and Caytoniales in Las Hoyas. The megafloreal assemblage shows the following features :

a) the occurrence of Coniferales and Bennettitales cones, which are related to stems, and on the other hand, the relative abundance of the remains of the soft parts of unidentified Ginkgoales species (ovules in pairs on a short stalk and catkinlike pollen organs), lead us to consider the bed as autochthonous. The Bennettitales are usually considered to be members of warm-temperate and subtropical floras ;

b) the abundance (nearly 32 % from the available data) of *Montsechia vidali* (ZEILLER) TEXEIRA. This species has been considered as characteristic of the Montsech beds (Barale *et alii* 1984) and, moreover, as a possible hydrophyte plant. We agree with this interpretation, but we have not yet found any hydrophyte such as *Yuccites* or *Ranunculus* at Las Hoyas ;

c) the Filicales are scarce, with only two species : *Cladophlebis browniana* (DUNKER) SEWARD and *Weichselia reticulata* (STOKES & WEBB) FONTAINE emend. ALVIN. For a while, this latter species was considered a xerophyte plant inhabiting sand dunes, because most of the material of *Weichselia* occurred in sandstone and its morphological and anatomical characteristics suggest the same. Nowadays, according to many authors, *Weichselia* is thought to have dwelt in coastal, marshes or treeless bogs, on wet ground that underwent subtropical, seasonal or temporary periods of drying ;

d) the presence (only one specimen) of *Cupressinocladus micromerum* (HEER) PAIS reported for the first time in Spain, although this species is very common in Portugal ;

e) considering the toposuccession there are an hydrophitic vegetation (*Montsechia*), a coastal vegetation (*Weichselia*), a slope vegetation (Ginkgoales) and an upland vegetation (Coniferales).

The two species of crustaceans found in Las Hoyas are common with Montsech. The diversity of insects from Las Hoyas seems, at first glance, greater than that of the Catalonian fossil-site. Most of the insects from Las Hoyas are aquatic dwellers. The absence of adult representatives of the Dipters and Hymenoptera is worth remarking.

The material found in Las Hoyas comprises many remains of fish which give evidence of an abundant and varied fauna including very many actinopterygians and an actinistian coelacanthid. At least 10 genera belonging to 9 families have already been identified. New findings will be necessary in order to give a detailed description of some species present at Las Hoyas - but not sufficiently frequent - and to identify those which are too scarcely represented in existing collections.

The Las Hoyas ichthyological fauna is characterized by the great number of small-sized specimens, amongst which juvenile individuals can be recognized by the shape and size of the body, by the aspect of the rays, and in some cases by the fact that the scales have not yet appeared.

This fauna does not include, at present, any selachian, and the actinistians are very scarce. The actinopterygians are represented by various "holosteans", but with relatively few individuals. They are also represented by teleosteans, less diversified but more numerous. These are mostly whole and uncrushed skeletons, suggesting at the most a short distance transport. Juvenile individuals, although fragile are remarkably numerous, well preserved and varied. They were probably found close to an environment which was favourable for their development.

The fish assemblage and the relative proportions of the various elements (both in the number of species and the number of individuals) are characteristic of the Upper Jurassic and Lower Cretaceous faunas. It is with the Montsech fossil locality (province of Lérida, Spain) that the Las Hoyas fossil locality is the most closely related. Every taxon identified at the species level is also present in the Montsech. Research in Las

Hoyas being very recent, the absence of species which are very rare in the Montsech (*Hybodus woodwardi*, *Ophiopsis montsechensis*) is not significant. To the contrary, the absence at Las Hoyas of species relatively frequent in the Montsech (*Proterus vidali*, "*Anaethalion*" *vidali*) could indicate a real difference. The frequent appearance of a small size *Lepidotes*, as compared with its extreme scarceness in the Montsech, has already been emphasized.

With the exception of genera up to now specific of the Montsech (*Vidalamia*, *Rubiesichthys*), all the genera known at Las Hoyas have been recorded from both marine and fresh water deposits. By comparison with Upper Jurassic marine faunas (Bavaria, Cerin, Great Britain) and to a lesser degree by comparison with Lower Cretaceous ones (Canjuers), the Montsech and Las Hoyas are remarkable by an impoverishment of

the fish fauna, by the lack of diversity of the pycnodontid species, and by the presence of the same channiid, *Rubiesichthys gregalis* (outside of these two localities, the latter family is known in the Wealden of Bernissart with the closely related species *Anaethalionopsis robustus*).

The limestones from Las Hoyas correspond to a lacustrine environment. Terrestrial plants, insects and some vertebrates lived on the banks of the lakes, while fishes, crustaceans and charophytes inhabited the shallow and well oxygenated littoral waters. Biologically produced entities drifted on the surface before sinking to deeper parts of the lake and finally to an anaerobic bottom, quiet and free from scavengers, where they were accumulated and preserved.

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PLATE 1

Bar : 1 cm.

Fig. 1 - *Toxochelyidae* indet. (Chelonia).

Fig. 2 - *Lacertilia* indet. (Squamata) (LH 369R).

Fig. 3 - *Pseudoastacus llopsi* (Crustacea).

Fig. 4 - Wing of an aeschnidiid dragonfly (Insecta, Odonata).

Aile d'une libellule aeschnidiide.

Fig. 5 - Cupedoid beetle (Insecta, Coleoptera).

Scarabée cupédoïde.

Fig. 6 - Aquatic heteroptera. Family Corixidae (Insecta, Hemiptera).

Hétéroptère aquatique.

Fig. 7 - New genus and species of Caudata (Amphibia) (LH 001).

Nouveau genre et espèce de Caudata.

Fig. 8 - *Sphenolepis kurriana* (Pinopsida).

Fig. 9 - *Montsechia vidali*.

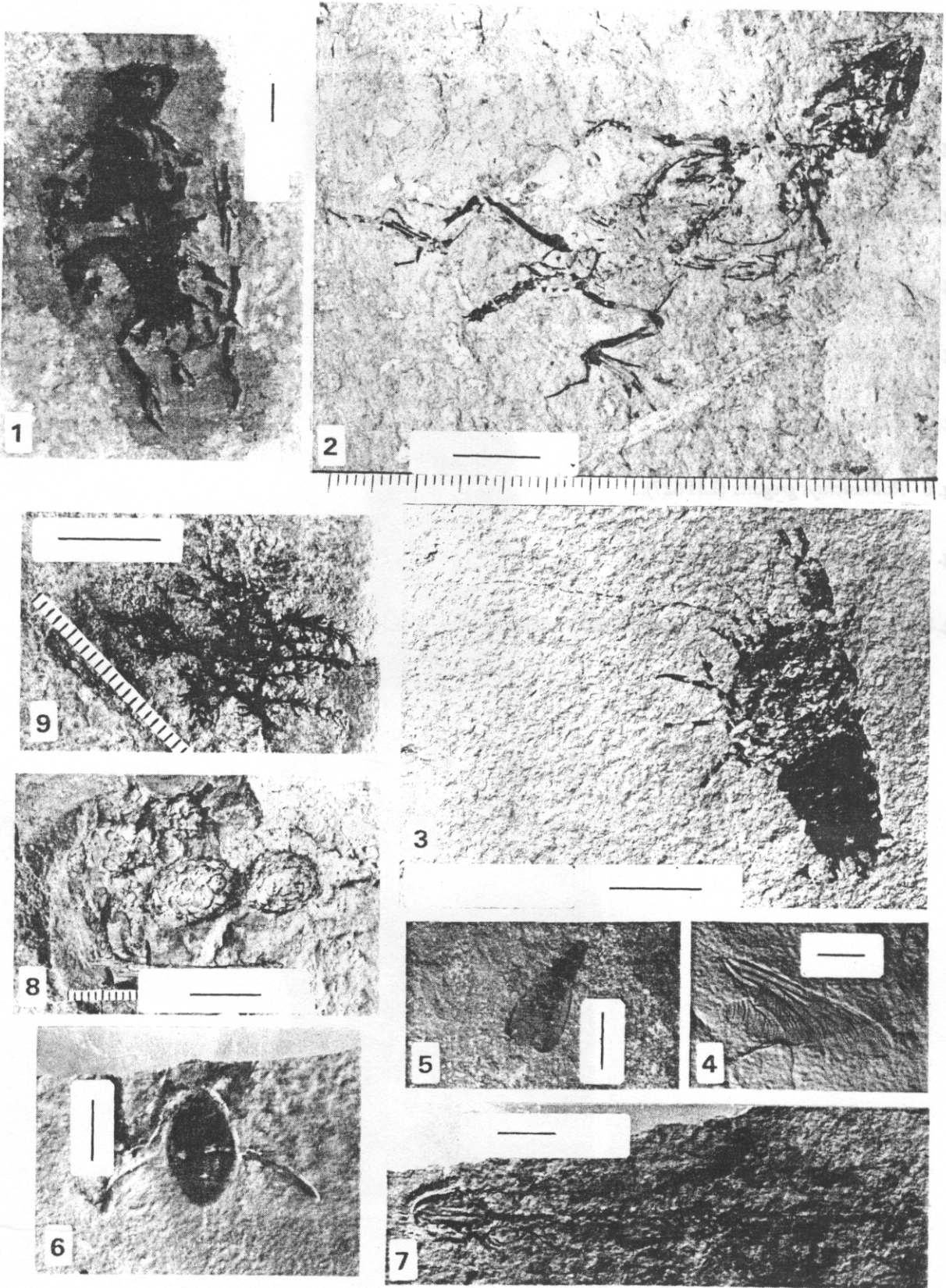


PLATE 2

Fig. 1 - *Lepidotes* sp. (LH 016).

Fig. 2 - *Urocles woodwardi* (LH 023)

Fig. 3 - *Notagogus ferreri* (LH 011).

Fig. 4 - ? *Ascalabos voithi* (LH 164)

Fig. 5 - *Pleuropholis* sp. (LH 771).

Fig. 6 - *Rubiesichtys gregalis* (LH 627).

Fig. 7 - ? "*Holophagus*" *leridae* (LH 007).

Fig. 8 - Pycnodontiformes genus incertae sedis : dentalosphenial (LH 1133).

