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SOME SPANISH CRETACEOUS BIVALVES

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ABSTRACT

This paper discusses a selection of Bivalves (*Ostreacea*, *Pectinidae*, *Limidae*, *Spondylidae*) from Spanish Cretaceous deposits. By using modern nomenclature, comparison of Spanish faunas with those from deposits outside Spain becomes possible. Tentative palaeobiogeographical conclusions resulting herefrom are:

1. Aptian bivalves from Eastern Spain are very similar with those from Eastern France and Switzerland.
2. Cenomanian bivalves from Somolinos (Guadalajara) and from Tejada (Burgos) have very many species in common with Le Mans (France) and Upper Greensand faunas as known from Warminster and other localities in England, but next to those species a few Tethyan elements occur.
3. Santonian bivalve faunas from the Prepyrenees (mainly Lérída) are very close to faunas from the Provence and from the Gosau deposits in Austria: thus they belong to the Northern Tethys.
4. Campanian and Maastrichtian deposits of the same region contain faunal elements at the same time close to those of the Aquitaine, to those of North Africa, and possibly also endemic factors.

RESUMEN

En este trabajo se presenta una selección de Bivalvos (*Ostreacea*, *Pectinidae*, *Limidae*, *Spondylidae*) del Cretácico español. El uso de

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una nomenclatura moderna permite establecer comparaciones entre las faunas españolas y las de otros países.

A continuación se exponen los resultados de un intento de conclusiones paleogeográficas:

1. Los bivalvos aptenses del Este de España son muy semejantes a los del Este de Francia y Suiza.

2. Los bivalvos cenomanenses de Somolinos (Guadalajara) y de Tejada (Burgos) presentan muchas especies en común con Le Mans (Francia) y las faunas de la «Upper Greensand» reconocida en Warminster y otras localidades inglesas; sin embargo, junto a ellas hay algunos elementos del Tethys.

3. Las faunas de bivalvos santonienses de los Prepirineos (Lérida principalmente) se aproximan mucho a las faunas de Provenza y de los depósitos de Gosau, en Austria: así, pues, pertenecen al Tethys septentrional.

4. Los depósitos del Campaniense y Maastrichtiense de dichas regiones contienen, además, elementos faunísticos relacionados tanto con los de Aquitania como con los del Norte de Africa, y posiblemente algunos factores endémicos.

INTRODUCTION

Spanish Cretaceous bivalves have been studied for about 150 years. Spanish localities and specimens are mentioned in some of the fundamental Western European stratigraphical works [f. i. d'Orbigny's *Prodrome* (1850)].

Spanish Cretaceous faunas are important: the Iberian Peninsula was placed between the Tethys and Western Europe (and was before the widening of the North Atlantic not even far from North America). Some Spanish areas during the Cretaceous had faunas almost identical with Western Europe (such as the Aptian around Morella or the Cenomanian of Somolinos); other faunas were purely Tethyan; again other faunal entities were of marginal Tethys affinity (the Prepyrenean Santonian-Campanian faunas had characteristics of Aquitaine, Provence and Austria).

The study of the Cretaceous bivalves from Spain has unfortunately often been undertaken with a strong provincial bias, by Spanish and by non-Spanish authors; also some publications on Spanish bivalves have not been generally easily accessible to the rest of the world: this results in a nomenclative usage rather different from the rest of Europe.

In this paper, no attempt has been made at giving a complete review of Spanish Cretaceous bivalves: I have intentionally limited myself to the material which I have been able to study (the collections and field localities are referred to in appendix). Though they belong to the same palaeogeographical entities, the Portuguese Cretaceous species have been omitted for practical reasons. The purpose of the paper is to give a readjusted nomenclature; by using those 'new' names, palaeobiogeographical interpretation becomes easier.

FAUNAS

For each species mentioned, the stratotype and type area or locality are indicated, a good figure is referred to, the palaeogeographic distribution briefly stated and the occurrences in Spain listed.

PECTINIDAE

Camptonectes virgatus (NILSSON, 1827): originally described from the Swedish Late Campanian; fig. in Dhondt (1972 a, pl. 2, fig. 1); distribution: ubiquitous from the Mid Cenomanian to terminal Maastrichtian.

Occurrence in Spain: Santonian: *Lérida*: Collades de Bastus (I. Br.).

Chlamys achates (COQUAND, 1865): originally described from the Aptian of «Quatre-Dineros et Parras Martin (Aragón)»: type specimens in the MAFI coll., Budapest (Hungary); fig. herein pl. 1, fig. 7 and 8; distribution: only known from the Aptian of Spain: *Aragón*: Coquand localities (MAFI), *Castellón*: Morella (Sem. B., U. Val.), Olocau del Rey (Sem. B.), *Tarragona*: Puente del Aliga, Ametlla de Mar (Sem. B.), *Teruel*: Mas Antonino, Peñarroya de Tastavins (Sem. B.).

Chlamys elongata (LAMARCK, 1819): originally described from the Cenomanian of Le Mans (France); fig. in Dhondt (1973 b, pl. 2); distribution: widely distributed from the Aptian to the terminal Cenomanian in temperate seas.

Occurrence in Spain: Cenomanian: *Navarra*: Orobe Alsasua (Sem. B.).

Chlamys espaillaci (D'ORBIGNY, 1847): originally described from the «Senonian» of the Charente and the Dordogne (France); fig. in d'Orbigny (1847, pl. 439, figs. 1, 4).

Occurrence in Spain: Santonian: *Lérida*: Montsec (Mus. B.), Maastrichtian: *Barcelona*: Figols-las-Minas (Sem. B.).

Chlamys cf. *faujasi* (DEFrance, 1825): originally described from the Sint Pietersberg near Maastricht (the Netherlands), Late Maastrichtian; fig. in Dhondt (1973 b, pl. 1, fig. 2); distributed in temperate seas from latest Cenomanian to terminal Maastrichtian. Probable occurrence in Spain: Upper Coniacian: *Navarra*: Olazagutía (I. B. R.).

Chlamys subacuta (LAMARCK, 1819): originally described from the Cenomanian of Le Mans (France); fig. in Dhondt (1973 b, pl. 4); distributed in temperate and northern Tethys deposits of Albian and Cenomanian age.

Occurrence in Spain: Cenomanian: *Guadalajara*: Somolinos (Sem. B.), *Soria*: Picofrentes (I. Br.).

Entolium membranaceum (NILSSON, 1827): originally described from the Late Campanian in Köpings (Sweden); fig. in Dhondt (1971, pl. 1, fig. 2); widely distributed in temperate seas from the latest Cenomanian to the terminal Maastrichtian.

Occurrence in Spain: Turonian VIII: *Navarra*: Orogoyen (I. Br.); Coniacian: *Navarra*: Zudaire (I. Br.); Late Coniacian: *Lérida*: near Herbasina (see Pons et al., 1981, p. 60) (I. Br.).

Entolium orbiculare (SOWERBY, 1817): originally described from the Greensand in Devizes (England) (Cenomanian); fig. in Dhondt (1971, pl. 1, fig. 1) and in B. M. F. (1975, pl. 56, fig. 2); widely distributed in «boreal» to temperate deposits from the Ryazanian to the Late Cenomanian.

Occurrence in Spain: Aptian: *Castellón*: Alcalá-de-Chivert, NE Rasfall (Sem. B.).

Merklinia catalaunica (VIDAL, 19221): originally described from the Campanian of Gosol (*Lérida*); fig. Vidal (1921, pl. 2, fig. 4, pl. 4, figs. 4, 5). The paper by Vidal was not noticed outside Spain; the species was also described as *Merklinia perornata* (Cottreau, 1922), see in Dhondt (1976, pp. 14-18, pl. 2, fig. 2); this species is widely distributed in the Tethys in the Campanian-Maastrichtian: Madagascar, North Africa, Spain and Cuba.

Occurrence in Spain: Campanian-Maastrichtian: *Barcelona*: Falgars (Sem. B.), Figols-las-Minas (Sem. B.), La Nou, Priorat, Berga (Sem. B.), St. Julia de Cerdanyola, Guardiola de Bergueda (Sem. B.);

Lérida: Serra-del-Verd, Tuixent (Sem. B.), La Tossa, Salas de Pallars (Areny Sandstone) (I. Br.).

Merklinia septemplicata (NILSSON, 1827): originally described from the Campanian of Sweden; fig. in Dhondt (1972 b, pl. 3, fig. 3 sub *Lyropecten septemplicatus*); widely distributed but rarely occurring from the Santonian to Late Maastrichtian: Sweden, Germany, Belgium-the Netherlands, Austria, Bulgaria.

Occurrence in Spain: Campanian: *Lérida*: Coll d'Ares, Montsec Section (I. Br.), Maastrichtian: *Lérida*: Serie V Homes Morts (Univ. Bell. coll. J. Gallemi).

Mimachlamys cretosa (DEFRANCE, 1822): originally described from the Craie de Meudon (near Paris, France) (Campanian); fig. in Dhondt (1973 b, pl. 6, fig. 2); widely distributed in temperate seas from the Turonian to terminal Maastrichtian.

Occurrence in Spain: Santonian: *Lérida*: Barranc de las Collades (I. Br.), Montsec (I. Br.).

Mimachlamys robinaldina (D'ORBIGNY, 1847): originally described from the Neocomian of Saint-Dizier (Haute-Marne, France); fig. in Dhondt (1973 b, pl. 7, fig. 2); very widely distributed from the Valanginian to the Late Cenomanian.

Occurrence in Spain: Cenomanian: *Navarra*: Monte Orobe-Alsua (Sem. B.).

Neithea(?) alpina (D'ORBIGNY, 1847): originally described from the Upper Cretaceous of SE France; fig. in d'ORBIGNY (1847, pl. 446, figs. 4-8); distributed from the Cenomanian to the Campanian (? Maastrichtian) of the Tethys.

Occurrence in Spain: Coniacian II-IV: *Burgos*: Villamartín (I. Br.); Santonian: *Lérida*: Montsec d'Ager (Sem. B.).

Neithea(?) dutrugei (COQUAND, 1862): originally described from the Cenomanian of Tenoukla (Algeria); fig. in Dhondt (1973 a, pl. 4, fig. 3, pl. 5, figs. 4 a, b); occurs from the Cenomanian to the Santonian of the Tethys.

Occurrence in Spain: Santonian: *Lérida*: Tuixent (Mus. B.).

Neithea hispanica (D'ORBIGNY, 1850): originally described from «Llama Oscura près de Oviedo» (Late Cenomanian); fig. by Roger (1956, fiche 44, Palaeontologia Universalis); widely distributed in the Tethys and in Africa in Late Cenomanian and Turonian deposits.

Occurrence in Spain: *Asturias*: Llama Oscura (Mus. P.), *Guadajara*: Somolinos (Sem. B.).

Neithea quinquecostata (SOWERBY, 1814): originally described from the Greensand in Chute (England) (Cenomanian); fig. in Dhondt (1973 a, pl. 2, figs. 2 a-c), distributed worldwide in Tethys and in temperate seas from the Albian to the terminal Maastrichtian. Occurrence in Spain: Cenomanian: *Soria*: Picofrentes (I. Br.); Upper Cenomanian: *Navarra*: Ganuza (I. Br.).

Neithea regularis (SCHLOTHEIM, 1813): originally described from the Sint Pietersberg near Maastricht (the Netherlands) (Late Maastrichtian); fig. in Dhondt (1973 a, pl. 1, fig. 3, pl. 2, figs. 1 a-d); widely distributed mainly in temperate seas from the latest Cenomanian to the terminal Maastrichtian.

Occurrence in Spain: Coniacian: *Burgos*: Terradillos de Sedano (I. Br.), Villamartín (I. Br.), *Lérida*: Herbasina (Pons et al., 1981, pp. 60-61, I. Br.); Santonian: *Burgos*: Lacazina Limestone: Torme (I. Br.), *Lérida*: Castello 500 E Sta. Engracia, Tremp (Sem. B.), Clot d'Olsi, Montsec (Univ. Bell.), Collades de Bastus (Univ. Bell.), Montsec (Mus. B.); Campanian-Maastrichtian: *Lérida*: Areny Sandstone: La Tossa (I. Br.).

Neithea sexangularis (D'ORBIGNY, 1847): originally described from the Campanian? of Pons (Charente, France); fig. in Dhondt (1973 a, pl. 3, fig. 3); occurred in the warm temperate seas of the Aquitaine (SW France) in Campanian times.

Occurrence in Spain: Campanian: *Lérida*: Vall de Lluc-Cornelles (Sem. B.), Tuixent (Sem. B.); Campanian-Maastrichtian: *Lérida*: Areny Sandstone: La Tossa (I. Br.).

Neithea sexcostata (WOODWARD, 1983): originally described from the Campanian of Norfolk (England); fig. in Dhondt (1973 a, pl. 5, figs. 2 a; 2 b) and in Woods (1903, pl. 40, figs. 10-15, pl. 41, figs. 1-10); distributed in temperate seas from the Late Albian to the terminal Maastrichtian.

Occurrence in Spain: Cenomanian: *Navarra*: Monte Orobe-Alsasua (Sem. B.).

Neithea stefanoi (CHOFFAT, 1900): originally described from the Bellasian of Bellas (Portugal); fig. in Choffat (1902, pl. 2, figs. 3 a, 3 b) (specimen in the Geological Survey of Portugal, Lisbon); species known from Portugal and possibly from Texas (USA).

Occurrence in Spain: Late Albian: *Albacete*: La Solana del Alambin, Almanca (Univ. Val.).

Neithea striatocostata (GOLDFUSS, 1833): originally described from Late Maastrichtian of Maastricht (the Netherlands); fig. in Dhondt (1973 a, pl. 3, figs. 2 a-d); widely distributed in the ?Santonian-Campanian-Maastrichtian of temperate seas.

Occurrence in Spain: Santonian: *Lérida*: Flamicell-Pallaresa Section (Pons *et al.*, 1981, pp. 23-27, I. Br.); Campanian: *Lérida*: Erinya (Mus. B.); Maastrichtian: *Barcelona*: Coll de la Subirana, Falgars (Sem. B.), Figols-las-Minas (Sem. B.).

Neithea syriaca (CONRAD, 1852): originally described from the Aptian at Abeih in Lebanon; fig. in Woods [1903, pl. 39, figs. 14-17, sub *Pecten*(*Neithea*)*morrissi*]; distributed in the Aptian and Albian, mainly from warm temperate and Tethys deposits.

Occurrence in Spain: Aptian: *Albacete*: Almansa (Univ. Val.), *Barcelona*: Garraf (Mus. B.), *Castellón*: Costa de Reinal (Sem. B.), Morella (Univ. Val.), *Tarragona*: Cañellas (Mus. B.), Cova del Vidre, Mas de Barberans (Sem. B.), Marmella (Mus. B., Sem. B.), Puerta del Aliga, Ametlla de Mar (Sem. B.).

Neithella notabilis (MÜNSTER in GOLDFUSS, 1833): originally described from the Cenomanian of Essen/Ruhr (GFR); fig. in Dhondt (1973 a, pl. 4, fig. 2); widely distributed from the Mid Albian to terminal Cretaceous.

Occurrence in Spain: Cenomanian: *Burgos*: Valdeporres (I. Br.), *Navarra*: Monte Orobe-Alsasua (Sem. B.).

Radiopecten cf. quinquenarius (CONRAD, 1853): originally described from the Delaware and Chesapeake Canal, Delaware (USA) (Late Campanian); fig. in Wade (1926, pl. 21, figs. 6, 7); this North American Campanian-Maastrichtian species has previously not been recorded from Europe; it was only known from the Gulf and Atlantic Coastal Plain deposits.

Probable occurrence in Spain: Campanian-Maastrichtian: *Lérida*: Areny Sandstone: La Tossa (I. Br., Univ. Bell.).

Syncyclonema greppini (PICTET and RENEVIER, 1858): originally described from the 'Marnes jaunes de la Perte du Rhône' (Ain, France, Aptian); fig. in Pictet and Renevier (1858, pl. 19, fig. 4); distributed in Aptian and Albian European deposits of temperate seas; very close to *Syncyclonema inconspicua* (Cragin, 1895) from strata of similar age in Texas.

Occurrence in Spain: Aptian: *Barcelona*: Garraf (Mus. B.).

Syncyclonema nilsoni (GOLDFUSS, 1835): originally described from the Maastrichtian of Maastricht (the Netherlands); fig. in Dhondt

(1971, pl. 4, figs. 1 a, 1 b); widely distributed in temperate, warm temperate and marginal Tethys deposits from the ?Cenomanian to the terminal Maastrichtian.

Occurrence in Spain: Coniacian I: *Burgos*: Villamartín (I. Br.).

SPONDYLIDAE

Spondylus spinosus (SOWERBY, 1814): originally described from Brighton and Northfleet (England) (Lower Senonian); fig. in Woods (1901, pl. 23, figs. 6-11, pl. 24, figs. 1-7); widely distributed in the Turonian-Late Campanian White Chalks.

Occurrence in Spain: Turonian: *Navarra*: Ollogoyen (I. Br.); Coniacian: *Burgos*: Terradillos de Sedano (I. Br.).

LIMIDAE

Lima catalaunica (VIDAL, 1921): originally described from the Santonian of the Montsech, Lerida; fig. in Vidal (1921, pl. 5, fig. 4); this species has so far only been described from Catalonia.

Other occurrences in Spain: Maastrichtian: *Barcelona*: La Nou, Priorat, Berga (Sem. B.), *Lérida*: Casa de las Cots, Gabana (Sem. B.).

Limaria dubisiensis (PICTET and CAMPICHE, 1870): originally described from the Valanginian near Sainte Croix, Vaud (Switzerland); fig. by Pictet and Campiche (1870, pl. 161, figs. 2 and 3); widely distributed in the Neocomian of the Tethys and warm temperate deposits.

Occurrence in Spain: Cretacico inf.: *Valencia*: Pont del Garrofer, Oliva (Sem. B.).

Limaria marticensis (MATHERON, 1842): originally described from Martigues near Marseille (France) in deposits of possibly Santonian age; fig. in Zittel (1866, pl. 16, figs. 1 a-d); distributed in the northern Tethys from Santonian to Campanian.

Occurrence in Spain: Santonian: *Lérida*: Clot d'Olsi, Montsec (Univ. Bell., I. Br.), Collades de Bastus (Univ. Bell., I. Br.), Montsec (Mus. B.).

Limatula fittoni (sensu D'ORBIGNY, 1847): originally described from the Upper Greensand of Blackdown (England); fig. in Woods (1904,

pl. 7, figs. 12-15); distributed in Late Albian and Cenomanian «sands».

Occurrence in Spain: Cenomanian: *Guadalajara*: Somolinos (Sem. B.), *Navarra*: Monte Orobe-Alsasua (Sem. B.).

Limatula semisulcata (NILSSON, 1927); originally described from the Campanian of Sweden; fig. in Marquet (1982, pl. 1, fig. 2); distributed in Europe in temperate and warm temperate seas of Coniacian to Late Maastrichtian age. Occurrence in Spain: Santonian: *Lérida*: Collades de Bastus (Univ. Bell.), Montsec (Mus. B.), Vilanova de Meja la Llobera (Sem. B.); Maastrichtian: *Lérida*: Sensuy (Sem. B.).

Plagiostoma cretaceum (WOODS, 1904): originally described from the White Chalk of Southern England; fig. in Woods (1904, pl. 4, figs. 13-15, pl. 5, figs. 1-4); widely distributed mainly in temperate deposits from the Turonian to the Late Maastrichtian.

Occurrence in Spain: Santonian: *Lérida*: Clot d'Olsi, Montsec (I. Br.), Maastrichtian: *Lérida*: Sensuy (Mus. B.).

Plagiostoma santonense (D'ORBIGNY, 1847): originally described from the 'Lower Senonian' at Saintes (France) (Santonian); fig. in d'Orbigny (1847, pl. 425, figs. 1, 2); mainly known from Santonian deposits in Southern France.

Occurrence in Spain: Santonian: *Burgos*: Villamartín (I. Br.); *Lérida*: Collades de Bastus (Univ. Bell.).

Plagiostoma semiornatum (D'ORBIGNY, 1847): originally described from Le Mans (France) (Cenomanian); fig. in Woods (1904, pl. 3, figs. 14-16, pl. 4, fig. 1); distributed from the Late Albian to the terminal Cenomanian in temperate European deposits.

Occurrence in Spain: Cenomanian: *Guadalajara*: Somolinos (Sem. B.), Upper Cenomanian: *Soria*: Picofrentes (I. Br.).

? *Pseudolimea cottaldina* (D'ORBIGNY, 1847): originally described from the Aptian of Wassy (Haute-Marne, France); fig. in d'Orbigny (1847, pl. 416, figs. 1-5); widely distributed in Late Neocomian and Aptian deposits of temperate and border Tethys European and Western Asian seas.

Occurrence in Spain: Aptian: *Barcelona*: Garraf (Mus. B.), *Castellón*: Anroig-Chert (Sem. B.), Morella (Sem. B.), *Tarragona*: Cova del Vidre, Mas de Barberans (Sem. B.), Marmella (Mus. B., Sem. B.), Puerta del Aliga (Sem. B.), La Roqueta-Canyelles (Sem. B.).

OSTREACEA

For easier consultation by non-oyster specialists all the oyster genera are listed alphabetically, not taking into consideration whether they belong to the *Gryphaeidae* or the *Ostreidae*.

Aetostreon couloni (sensu D'ORBIGNY, 1847): according to Pervinquièrre, 1910, *Exogyra couloni* DeFrance, 1821 has been misinterpreted by later authors; the Neocomian species, more elongated and narrow than *Aetostreon latissimum*, has generally been referred to *A. couloni* and I continue to use the name with that meaning, fig. by d'Orbigny (1847, pl. 467, figs. 1-3, non pl. 466); distribution: widely distributed in the warm temperate and Tethyan Neocomian.

Occurrence in Spain: Neocomian: *Valencia*: Oliva (Sem. B.); Hauterivian: *Castellón*: Chert (Sem. B.), La Querola, Concentaina (Sem. B.), San Mateo (Sem. B.).

Aetostreon latissimum (LAMARCK, 1801): neither in 1801 nor in 1819 did Lamarck indicate the locality from where his specimen was collected; Pervinquièrre (1910) suggested that it came from the Aptian of the Eastern side of the Paris Basin (Dept. Haute Marne or Aube); fig. in Pervinquièrre (1910, fiche 194, Palaeontologia Universalis, figs. H, Ha, Hb, Hc) in Stenzel (1971, p. N1117, fig. J 92, 1); widely distributed in Aptian warm temperate and Tethyan deposits.

Occurrence in Spain: Aptian: *Barcelona*: C. Almirall, St. Père de Ribes (Sem. B.), *Castellón*: Corachar (Sem. B.), Forcall (Sem. B.), Fredes-Costa Reinald (Sem. B.), Olocau del Rey (Sem. B.), *Tarragona*: Cova del Vidre, Mas de Barberans (Sem. B.), *Teruel*: Cañizar del Olivar (Sem. B.), Castellote (Sem. B.), Mirambell (Sem. B.).

Amphidonte obliquatum (PULTENEY, 1813): originally described from the Cenomanian of Melbury (Dorset, England); fig. in B.M.F. (1975, pl. 55, figs. 4-5); distributed in the Late Aptian to Late Cenomanian, generally known as *Exogyra conica* (Sowerby).

Occurrence in Spain: Aptian: *Asturias*: Nara (Sem. B.), Xixun (Sem. B.), Cenomanian: *Burgos*: Sierra de Tejada (Sem. B.), *Guadalajara*: Somolinos (Sem. B.), *Navarra*: Ganuza (I. Br.), *Soria*: Picofrentes (Sem. B.).

Ceratostreon flabellatum (GOLDFUSS, 1833): originally described from Saumur (France) and Boesingfeld (Germany); fig. in Bayle (1878, pl. 133); distributed in Albian-Cenomanian of warm temperate seas.

Occurrence in Spain: Late Albian: *Albacete*: Tejar de Bolarin (I. Br.), Cenomanian: *Burgos*: Tejera (Sem. B.), Valdeporres (I. Br.), *Guadalajara*: Albendiego (Sem. B.), Atienza (Sem. B.), Condemios de Abaja (Sem. B.), Somolinos (Sem. B.).

Ceratostreon pliciferum (DUJARDIN, 1837): originally described from the 'craie tufau' of Touraine, France (here: Coniacian-Santonian); fig. in Bayle [1878, pl. 134, figs. 1, 2, 10, 11, sub *Ceratostreon matheroni* (d'Orbigny), in Stenzel (1971, pp. N1118-1119, fig. J 92, 2 a-d sub *Ceratostreon spinosum* (Mathéron)]; distributed from the Turonian to terminal Maastrichtian in shallow, warm temperate and Tethys deposits.

Occurrence in Spain: Turonian: *Soria*: Picofrentes (Sem. B.), Coniacian II-IV: *Burgos*: Villamartín (I. Br.), Santonian: *Burgos*: Lacazina Limestone: Torme (I. Br.); Villamartín (I. Br.), *Lérida*: Clot d'Olsi, Montsec (Univ. Bell., I. Br.), Collades de Bastus (Univ. Bell.), Montsec (Mus. B.); Maastrichtian: *Barcelona*: Falgars, Pobla de Lillet (Sem. B.), *Burgos*: Torme section (I. Br.), *Lérida*: Castello Santa Engracia, Tremp (Sem. B.), Sensui (Sem. B.), *Navarra*: Puerto de Olazagutia (I. Br.).

Ceratostreon tuberculiferum (KOCH and DUNKER, 1837): originally described from Elligser Brink (near Hannover, G. F. R.) (? Aptian); fig. pl. 1, figs. 1-5 and in Woods (1913, pl. 61, figs. 7-11); distributed from the Valanginian to the Aptian (? Albian).

Occurrence in Spain: Neocomian: *Valencia*: Oliva, Pont del Garrofer (Sem. B.), Aptian: *Castellón*: near Chert (Sem. B.), near Forcall (Sem. B.), near Fredes (Sem. B.), Mas de Cabra, Todobella (Sem. B.), near Morella (Sem. B.), near Olocau del Rey (Sem. B.), Vallibona (Sem. B.), Zoreta del Maestrazgo (Sem. B.); *Cuenca*: Casas Nuevas (Sem. B.); *Lérida*: Enforcadura del Pedraforca (Sem. B.), *Tarragona*: Les Clodes, Mas de Barberans (Sem. B.), near Marmella (Sem. B.), Tortosa (Sem. B.), Vallcañera (Sem. B.); *Teruel*: Josa la Tejeria (I. Br., Sem. B.), Obón, Ermita de San Miguel (Sem. B.).

Costagyra olisiponensis (SHARPE, 1850): originally described from near Lisbon (Portugal) (Late Cenomanian-Early Turonian); fig. in Stenzel (1971, p. N1117, fig. J 91); distributed in Late Cenomanian-Turonian of the Tethys.

Occurrence in Spain: Cenomanian: *Burgos*: Tejada (Sem. B.), *Guadalajara*: Somolinos (Sem. B.).

Gryphaeostrea canaliculata (SOWERBY, 1813): originally described from the Upper Greensand of Chute (England) (Cenomanian);

fig. in Woods (1913, pl. 56, figs. 2-16); very common in certain deposits from Aptian to terminal Maastrichtian; is often considered to have lived attached to mangrove roots.

Occurrence in Spain: Aptian: *Castellón*: in and around Forcall (Sem. B.), Morella (Sem. B.), *Tarragona*: Punta del Aliga, Amettla del Mar (Sem. B.).

Ilymatogyra pellicoi (VERNEUIL et COLLOMB, 1853): originally described from «Cueva del Vidrio près Tortosa»; fig. pl. 1, figs. 9-12; systematic note: Coquand (1869, p. 162) considered *Ostrea pellicoi* as a variety of *O. boussingaulti* d'Orbigny. I consider this most unlikely: the radial ornamentation of *O. pellicoi*, as stated by de Verneuil, is more or less parallel with the longitudinal spiral of the valve, whereas in *O. boussingaulti* (as understood by Coquand, a *Ceratostreon* spec. close to *C. tuberculiferum*) a longitudinal fold is intersected by plicae more or less at right angles with the major fold. *Ilymatogyra pellicoi* is so far only known from the Aptian of Spain: *Castellón*: An Roig, Chert (Sem. B.), in and around Forcall (Sem. B.), Morella (Sem. B.), Olocau del Rey (Sem. B.), Todobella (Sem. B.), Zoreta del Maestrazgo (Sem. B.); *Tarragona*: Cova del Vidre, Mas de Barberans (Sem. B.), Puente del Aliga, Amettla de Mar (Sem. B.), Vallcañera, La Cenia (Sem. B.); *Teruel*: Josa la Tejería (Sem. B.).

Ilymatogyra cf. *pseudoafricana* (CHOFFAT, 1886): originally described from the Bellasian of Portugal; fig. in Choffat (1886, pl. 4, figs. 1-4); distributed in the Iberian Peninsula and in North Africa. Occurrence in Spain: Cenomanian: *Burgos*: Tejada (Sem. B.), *Guadalajara*: Atienza (Sem. B.), El Atanze (Sem. B.), Somolinos (Sem. B.); Turonian: *Soria*: Picofrentes (Sem. B.).

Nicaisilopha nicaisei (COQUAND, 1862): originally described from the Campanian of the province of Constantine (Algeria); fig. in Stenzel (1971, pp. N1164-1165, fig. J 137); distributed in the Tethys from the Turonian to the Maastrichtian. Occurrence in Spain: Campanian: *Lérida*: Os da Balaguer (Mus. B.).

Pycnodonte biauriculatum (LAMARCK, 1819): originally described from Le Mans, France (Cenomanian); fig. in Bayle (1878, pl. 137, figs. 1-4); distributed in Late Cenomanian strata of warm temperate and northern Tethys regions. Occurrence in Spain: *Burgos*: Tejada (Sem. B.).

Pycnodonte vesiculare (LAMARCK, 1806): originally described from Meudon near Paris, France (Late Senonian, probably Campanian); fig. in B. M. F. (1975, pl. 59, figs. 1, 2); widely distributed in temperate and Tethys seas from the Albian till the terminal Maastrichtian (Danian?).

Occurrence in Spain: Coniacian: *Lérida*: Collada Gassó (Carregador de Carreu Marly Limestone, Pons *et al.*, 1981, pp. 56-59) (I. Br.); Santonian: *Barcelona*: La Nou (Sem. B.), *Lérida*: Collades de Bastus (I. Br.); Campanian-Maastrichtian: *Lérida*: Areny Sandstone: La Tossa (I. Br.); Maastrichtian: *Barcelona*: St. Julia de Cerdanyola (Sem. B.), *Lérida*: La Rua, Tremp (Sem. B.).

Pycnodonte vesiculare subsp. *nikitini* (ARKHANGUELSY, 1905): originally described from the Coniacian-Santonian and from the Maastrichtian of the Russian platform: a small almost comma-shaped *Pycnodonte vesiculare* subspecies which at certain times occurred in great numbers, mainly in the Lower Santonian; Renngarten named this subspecies *Pycnodonte subvesiculosa* Renngarten, 1964; his specimens are from the Caucasus.

Occurrence in Spain: Santonian: *Burgos*: Villamartín (I. Br.), *Lérida*: Collado Gasso: Carregador de Carreu (Pons *et al.*, pp. 56-59, 1981) (I. Br.), Maastrichtian: *Lérida*: Castello 500 m E of Santa Engracia (Sem. B.).

Pycnodonte vesiculosum (SOWERBY, 1822): originally described from the Upper Greensand of Warminster (England) (Cenomanian); fig. in Woods (1913, pl. 55, figs. 10-14, pl. 56, fig. 1); known from the Late Albian and Cenomanian of temperate seas.

Occurrence in Spain: Upper Cenomanian: *Navarra*: Ganuza (I. Br.).

Rhynchostreon suborbiculatum (LAMARCK, 1801): originally described from Le Mans (France) (terminal Cenomanian); fig. in Stenzel (1971, pp. N 1119-1120, fig. J 94, 1); widely distributed in Late Cenomanian-Turonian (? Coniacian) deposits; generally known as *Exogyra columba* (Lamarck).

Occurrence in Spain: Late Cenomanian: *Burgos*: Tejada (Sem. B.).

DISCUSSION AND CONCLUSIONS

The data discussed in this paper give only a very incomplete view of the Spanish Cretaceous bivalves, even of those from the four groups considered. Tentatively, a few conclusions can be indicated:

1. Aptian faunas from Eastern Spain: 9 species, 2 of which seem to be endemic to Spain; the other species belong to a typical Tethys assemblage: many species are common with Eastern France, fewer with Southern England: undoubted similarity with the Middle East-Western Asian Tethys.

2. Cenomanian faunas from NW Spain:

Species	Somolinos	Picofrentes	Tejada	Navarra
<i>Chl. elongata</i>				+
<i>Chl. subacata</i>	+	+		
<i>Mi. robinaldina</i>				+
<i>Nei. hispanica</i>	+			
<i>Nei. quinquecostata</i>		+		
<i>Nei. sexcostata</i>				+
<i>Nei. notabilis</i>				+
<i>Lim. fittoni</i>	+			+
<i>Pla. semiornatum</i>	+	+		
<i>Amph. obliquatum</i>	+	+	+	+
<i>Cer. flabellatum</i>	+		+	
<i>Cost. olisiponensis</i>	+		+	
<i>Ilym. pseudoafricana</i>	+	+	+	
<i>Pyc. biauriculatum</i>			+	
<i>Pyc. vesiculosum</i>				+
<i>Rhy. suborbiculatum</i>			+	

The faunas from Navarra (Monte Orobe and Ganuza) only contain species known from S. England and the region around Le Mans (France); the three other regions contain species from Tethys faunas as well as from temperate shallow faunas and seem to have been at least partially stratigraphically somewhat younger.

3. Santonian faunas from Lerida: 14 species, of which 3 are definitely Tethyan, 9 are common with the faunas of similar age in the Charente and Dordogne, 7 also occur in the Gosau deposits of Austria.

4. Campanian-Maastrichtian faunas of Catalonia: also 14 species, of which one is endemic, two are definitely Tethyan, one is North American, 9 are common with the faunas from the Charente, 7 are also known from the stratotypical Maastrichtian, 4 are known from the White Chalk deposits of similar age in Northern Europe.

Hence, the faunas herein considered, mainly from Northern Spain seem to be closer to those of the border Tethys region, after Aptian times.

APPENDIX

List and abbreviations of collections mentioned

I. Br.: Department of Palaeontology, KBIN, Brussels; MAFI: Magyar Allami Földtani Intézet, Budapest; Mus. B.: Museo geológico, Barcelona (Ciudadela); Mus. P.: Institut de Paléontologie, Muséum national d'Histoire naturelle, Paris; Sem. B.: Seminario Barcelona, Laboratorio del CSIC.

Univ. Bell.: Universidad Autónoma Barcelona, Bellaterra, Departamento Paleontología; Univ. Val.: Universidad Valencia, Paleontología.

Excursions during which material was collected

Mid Cretaceous Events, Iberian Field Conference, 1977: part II lead by J. Wiedmann, part III lead by L. Vilas and his colleagues.

Working Group Coniacian to Maastrichtian Stages, Third Working Session, Tremp, 1981, lead by J. M. Pons and his colleagues for part I, and by J. Wiedmann and M. Lamolda for part II.

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PLATE I

- FIGS. 1-5.—*Ceratostreon tuberculiferum* (Koch and Dunker): X 1, Josa la Tejeria, Teruel, Aptian (I. Br).
- FIG. 6.—*Merklina septemplicata* (Nilsson): X 1, Serie V Homes Morts, Lérida, Maastrichtian (Univ. Bell.: coll. J. Gallemi).
- FIG. 7-8.—*Chlamys achates* (Coquand): X 1, Fig. 7: right valve; Fig. 8: left valve, C₁ 131063 (Univ. Tübingen: coll. J. Wiedmann).
- FIGS. 9-12.—*Ilymatogyra pellicoi* (de Verneuil and Collomb): X 3, Figs. 9 and 10: Mas de Roc, Forcall, Castellón, Aptian (Sem. B.); Figs. 11 and 12: Mas de Cabra, Todobella, Castellón, Aptian (Sem. B.).



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